SCIENCE

FRIDAY, DECEMBER 29, 1899.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*SCIENTIFIC THOUGHT IN THE NINETEENTH CENTURY.**

IT is an interesting fact that the life of our Association is almost coextensive with that nineteenth century of Christian civilization which is now drawing to a close. In intellectual, as in physical phenomena, we are tempted to overestimate the magnitude of near objects and to underestimate that of distant ones; but science and art tend to advance with accelerated velocity, and we are undoubtedly right in ranking the achievements of our age in science and its applications as far greater than those of any previous century.

When our predecessors assembled a hundred years ago to organize this Academy, they could avail themselves of no other means of transportation than those which were in use before the time of Homer. If the distances over land were too great for convenient walking, they were carried or drawn by horses. If they had occasion to cross bodies of water, they used oars or sails. We have been brought to our destination to-day by the forces of steam and electricity.

The harnessing of these mighty forces for man's use has transformed not only the modes of transportation, but the processes of production of all kinds of commodities.

* Address at the Centennial Celebration of the Connecticut Academy of Arts and Sciences, October 11, 1899.

It has wrought a revolution in the whole industrial system. The day of the small workshop is gone. The day of the great factory is come. Every phase of human life is affected by those arts which have arisen from the applications of science. Comforts and luxuries which a hundred years ago were beyond the reach of the most wealthy, are now available for the use of even the poor. Aniline dyes give to fabrics used for clothing or decoration colors beside which those of the rainbow are pale neutral tints. Sanitary science arrests the massacre of the innocents, and increases the average duration of human life. Anæsthetics and antiseptics take away from surgery its pain and its peril.

But, though our Association is an Academy of Arts and Sciences, it has, at least in its later life, devoted itself chiefly to the cultivation of pure science, leaving to other organizations the development of the applications of science. Fitly, then, our thoughts to-day dwell, not upon the vast progress of the useful arts, but upon the progress of pure science. Not the economic and the industrial, but the intellectual history of our century claims our attention.

I do not propose, in the few moments allotted to me this afternoon, to give an inventory of the important scientific discoveries of the nineteenth century. The time would not suffice therefor, even were my knowledge of the various sciences sufficiently encyclopædic to justify me in the attempt. I wish rather to call your attention to a single broad, general aspect of the intellectual history of our age. I wish to remind you in how large a degree those general ideas which make the distinction between the unscientific and the scientific view of nature have been the work of the nineteenth century.

The first of these ideas is the extension of the universe in space. The unscientific mind looks upon the celestial bodies as mere appendages to the earth, relatively of small size, and at no very great distance. The scientific mind beholds the stellar universe stretching away, beyond measured distances whose numerical expression transcends all power of imagination, into immeasurable immensities.

The second of these ideas is the extension of the universe in time. To the unscientific mind, the universe has no history. Since it began to exist, it has existed substantially in its present condition. Among Christian peoples, until the belief was corrected by science, the Hebrew tradition of a creative week six thousand years ago was generally accepted as historic fact. If, on the other hand, unscientific minds not possessed of any supposed revelation in regard to the date of the world's origin, thought of the universe as eternal, that eternity was still conceived as an eternity of unhistoric monotony. The scientific mind sees in the present condition of the universe the monuments of a long history of progress.

The third of these ideas is the unity of the universe. To the unscientific mind the universe is a chaos. To the scientific mind it becomes a cosmos. To the unscientific mind, the processes of nature seem to be the result of forces mutually independent and often discordant. Polytheism in religion is the natural counterpart of the unscientific view of the universe. To the scientific mind, the boundless complexity of the universe is dominated by a supreme unity. One system of law, intelligible, formulable, pervades the universe, through all its measureless extension in space and time. The student of science may be theist or pantheist, atheist or agnostic; polytheist he can never be.

What then, let us ask ourselves, has been the contribution of our century to the development of these three ideas, which characterize the scientific view of nature :—the spatial extension of the universe, the his-

toric extension of the universe, and the unity of the universe.

The development of the idea of the extension of the universe in space belongs mainly to earlier times than ours. The Greek geometers acquired approximately correct notions of the size of the earth and the distance of the moon. The Copernican astronomy in the sixteenth century shifted the center of the solar system from the earth to the sun, and placed in truer perspective our view of the celestial spheres. But, though astronomy, the oldest of the sisterhood of the sciences, attained a somewhat mature development centuries ago, it has in our own century thrown new light upon the subject of the vastness of the universe. The discovery of Neptune has greatly increased the area of the solar system; the measurement of the parallax of a few of the brightest and presumably the nearest of the stars has rendered far more definite our knowledge of the magnitude of the stellar universe; and telescopes of higher magnifying power than had been used before have resolved many clusters of small and distant stars.

If the development of the idea of the spatial extension of the universe belongs mainly to an earlier period, the idea of its historic extension belongs mainly to our century. It is true, indeed, that Pythagoras and others of the ancient philosophers did not fail to recognize indications of change in the surface of the earth. And, in the beginning of the Renaissance, we find Leonardo da Vinci and others insisting that the fossils discovered in excavations in the stratified rocks were proof of the former existence of a sea teeming with marine life, where cultivated lands and populous cities had taken its place. Hutton's 'Theory of the Earth,' which in an important sense marks the beginning of modern geological theorizing, appeared in the Edinburgh *Philosophical Transactions* in 1788, but was not published a sa separate work till seven years later. Not till 1815 was published William Smith's Geological Map of England, the first example of systematic stratigraphic work extended over any large area of country. To the beginning of our country belong also the classical and epoch-making researches of Cuvier upon the fossil fauna of the Paris basin. By far the larger part, therefore, of the development of geologic science, with its far-reaching revelations of continental emergence and submergence, mountain growth and decay, and evolution and extinction of successive faunas and floras, belongs to the nineteenth century. Far on into our century extended the conflict with theological conservatism, in which the elder Silliman, James L. Kingsley, and others of the early members of our Academy bore an honorable part, and which ended in the recognition, by the general public as well as by the select circle of scientific students, of an antiquity of the earth far transcending the limits allowed by venerable tradition.

To our century also belongs chiefly the development in astronomy of the idea of the history of the solar system. It is, indeed, true that, in the conception of the nebular hypothesis, Laplace, whose "Théorie de la Monde" was published in 1796, was preceded by Kant and Swedenborg; yet the credit of the discovery belongs not so much to the first conception of the idea as to its development into a thoroughly scientific theory. Our century, moreover, has added to those evidences of the nebular theory, which Laplace derived from the analogies of movement in the solar system, the evidence furnished by the spectroscope, which finds in the nebulæ matter in some such condition as that from which the solar system is supposed to have been evolved.

But by far the most important contribution of this century to the intellectual life

of man is the share which it has had in developing the idea of the unity of nature. The greatest step prior to this century in the development of that idea (and probably the most important single discovery in the whole history of science) was Newton's discovery of universal gravitation two hundred years ago; but the investigations of our century have revealed, with a fullness not dreamed of before, a threefold unity in nature—a unity of substance, a unity of force, and a unity of process.

Spectrum analysis has taught us somewhat of the chemical constitution, not only of the sun, but also of the distant stars and nebulæ; and has thus revealed a substantial identity of chemical constitution throughout the universe. Profoundly interesting, from this point of view, is the recent discovery, in uraninite and some other minerals, of the element helium, previously known only by its line in the spectrum of the sun. Profoundly interesting will be, if confirmed by further researches, the still more recent discovery of terrestrial coronium.

The doctrine of the conservation of energy formulates a unity of force in all physical processes. In this case, as in others, prophetic glimpses of the truth came to gifted minds in earlier times. Lord Bacon declared heat to be a species of motion. And Huyghens, in the seventeenth century, distinctly formulated the theory of light as an undulation, though the mighty influence of Newton maintained the emission theory in general acceptance for a century and a half.

When Lavoisier exploded the phlogiston theory, and laid the foundation of modern chemical philosophy, it was seen that, in every chemical change, there is a complete equation of matter. But there was in the phlogiston theory a distorted representation of a truth which the chemical theory of Lavoisier and his successors ignored. They could give no account of the light and heat and electricity so generally associated with chemical transformations. These "imponderable agents," as they were called, believed to be material, yet so tenuous as to be destitute of weight, haunted like ghosts the workshop of the artisan and the laboratory of the scientist, wonderfully important in their effects, but utterly unintelligible in their nature. It was almost exactly at the beginning of our century that the researches of Rumford discovered the first words of the spell by which these ghosts were destined to be laid. When Rumford declared, in his interpretation of his experiments, "Anything which any insulated body or system of bodies can continue to furnish without limitation, cannot possibly be a material substance," the fate of the supposed imponderable fluid heat was sealed; but it was not till near the middle of our century that Joule completed the work of Rumford by the determination of the mechanical equivalent of heat. About the same time, Foucault's measurement of the velocity of light in air and in water afforded conclusive proof of the undulatory theory of light. In these great discoveries was laid the strong foundation for the magnificent generalization of the conservation of energy—a generalization which the sagacious intuition of Mayer and Carpenter and Le Conte at once extended beyond the realm of inorganic nature to the more subtile processes of vegetable and animal life. In this connection, I may be pemitted to refer to the work of some of my colleagues, with the Atwater-Rosa calorimeter, which has given more complete experimental proof than had previously been given of the conservation of energy in the human body.

But by far the greatest of the intellectual achievements of our age has been the development of the idea of the unity of process pervading the whole history of nature. The word which sums up in itself the ex-

pression of the most characteristic and fruitful intellectual life of our age is the word evolution. The latter half of our century has been so dominated by that idea in all its thinking, that it may well be named the Age of Evolution. We may give as the date of the beginning of the new epoch the year 1858; and the Wittenberg theses of the intellectual reformation of our time were the twin papers of Darwin and Wallace, wherein was promulgated the theory of natural selection.

And yet, of course, the idea of evolution was not new, when these papers were presented to the Linnæan Society. Consciously or unconsciously, the aim of science at all times must have been to bring events that seemed isolated into a continuous development. To exclude the idea of evolution from any class of phenomena, is to exclude that class of phenomena from the realm of science. In the former half of our century, evolutionary conceptions of the history of inorganic nature had become pretty well established. The nebular hypothesis was obviously a theory of planetary evolution. The Lyellian geology, which took the place of the catastrophism of the last century, was the conception of evolution applied to the physical history of the earth.

Nor had there been wanting anticipations of evolution within the realm of biology. The author of that sublime Hebrew psalm of creation, preserved to us as the first chapter of Genesis, was in his way a good deal of an evolutionist. 'Let the earth bring forth,' 'let the waters bring forth,' are words that point to a process of growth rather than to a process of manufacture in the origination of living beings. In crude and vague forms, the idea of evolution was held by some of the Greek philosophers. Just at the beginning of our century Lamarck developed the idea of evolution into something like a scientific theory. Yet it is no less true that the epoch of evolution in human thought began with Darwin. Manifold suggestions there were of genetic relationships between different organisms, whether organic forms were studied by the systematist or the embryologist, the geographer or the paleontologist; but each and all found the path to any credible theory of organic evolution blocked by the stubborn fact that variations in species appeared everywhere to be limited in degree, and to oscillate about a central average type, instead of becoming cumulative from generation to generation. In the Darwinian principle of natural selection, for the first time, was suggested a force, whose existence in nature could not be doubted, and whose tendency, conservative in stable environment, progressive in changing environment, would account at once for the permanence of species through long ages, and for epochs of relatively rapid change. However Darwin's work may be discredited by the exaggerations of Weismannism, however it may be minified by Neo-Lamarckians, it is the theory of natural selection which has so nearly removed the barrier in the path of evolution, impassable before, as to lead, first the scientific world, and later the world of thought in general, to a substantially unanimous belief in the derivative origin of species. Certain it is that no discovery since Newton's discovery of universal gravitation has produced so profound an effect upon the intellectual life of mankind. The tombs of Newton and Darwin lie close together in England's Valhalla, and together their names must stand as the two great epoch-making names in the history of science.

Darwin's discovery relates primarily to the origin of species by descent with modification from preëxisting species. It throws no direct light upon the question of the origin of life. But analogy is a guide that we may reasonably follow in our think-

ing, provided only we bear in mind that she is a treacherous guide and sometimes leads astray. Conclusions that rest only on analogy must be held tentatively and not dogmatically. Yet it would be an unreasonable excess of caution that would refuse to recognize the direction in which analogy points. When we trace a continuous evolution from the nebula to the dawn of life, and again a continuous evolution from the dawn of life to the varied flora and fauna of to-day, crowned as it is with glory in the appearance of man himself, we can hardly fail to accept the suggestion that the transition from the lifeless to the living was itself a process of evolution. Though the supposed instances of spontaneous generation all resolve themselves into errors of experimentation, though the power of chemical synthesis, in spite of the vast progress it has made, stops far short of the complexity of protoplasm, though we must confess ourselves unable to imagine any hypothesis for the origin of that complex apparatus which the microscope is revealing to us in the infinitesimal laboratory of the cell, are we not compelled to believe that the law of continuity has not been broken, and that a process of natural transition from the lifeless to the living may yet be within reach of human discovery?

Still further. Are we content to believe that evolution began with the nebula? Are we satisfied to assume our chemical atoms as an ultimate and inexplicable fact? Herschel and Maxwell, indeed, have reasoned, from the supposed absolute likeness of atoms of any particular element, that they bear "the stamp of a manufactured article," and must therefore be supposed to have been specially created at some definite epoch of beginning. But, when we are speaking of things of which we know as little as we know of atoms, there is logically a boundless difference between saying that we know no difference between the atoms of hydrogen, and saying that we know there is no difference. Is it not legitimate for us to recognize here again the direction in which analogy points, and to ask whether those fundamental units of physical nature, the atoms themselves, may not be products of evolution? Thus analogy suggests to us the question, whether there is any beginning of the series of evolutionary changes which we see stretching backward into the remote past; whether the nebulæ from which systems have been evolved were not themselves evolved; whether existing forms of matter were not evolved from other forms that we know not; whether creative Power and creative Intelligence have not been eternally immanent in an eternal universe. I cannot help thinking that theology may fitly welcome such a suggestion, as relieving it from the incongruous notion of a benevolent Deity spending an eternity in solitude and idleness. The contemplation of his own attributes might seem a fitting employment for a Hindoo Brahm. It hardly fits the character of the Heavenly Father, of whom we are told that he 'worketh hitherto.'

In the last suggestion I have ventured outside the realm of science. But most men are not so constituted that they can carry their scientific and their philosophical and religious beliefs in compartments separated by thought-proof bulkheads. Scientific and philosophic and religious thought, in the individual and in the race, must act and react upon each other. It was, therefore, inevitable that our century of scientific progress should disturb the religious beliefs of men. When conceptions of the cosmos with which religious beliefs had been associated, were rudely shattered, it was inevitable that those religious beliefs themselves should seem to be imperilled. And so, in the early years of the century, it was said, if the world is more than six thousand years old, the Bible is a fraud,

and the Christian religion a dream. And later, it was said, if physical and vital forces are correlated with each other, there is no soul, no distinction of right and wrong, and no immortality. And again it was said, if species originate by evolution, and not by special creation, there is no God. So it had been said centuries before, if the earth revolves around the sun, Christian faith must be abandoned as a superstition. But in the nineteenth century, as in the sixteenth, the scientific conclusions won their way to universal acceptance, and Christian faith survived. It showed a plasticity which enabled it to adapt itself to the changing environment. The magically inerrant Bible may be abandoned, and leave intact the faith of the church in a divine revelation. The correlation of forces acting in the human cerebrum with those of inorganic nature may be freely admitted; and yet we may hold that there are other forms of causation in the universe than physical energy, and that the inexpugnable belief of moral responsibility is more valid than the strongest induction. The 'carpenter God' of the older natural theology may vanish from a universe, which we have come to regard as a growth and not a building; but there remains the immanent Intelligence

> "Whose dwelling is the light of setting suns,
> And the round ocean, and the living air,
> And the blue sky, and in the mind of man;"—

the God in whom 'we live and move and have our being.'

The church has learned wisdom. The persecution of Galileo is not likely to be repeated, nor even the milder forms of persecution which assailed the geologists at the beginning, and the evolutionists in the middle, of our century. And science, too, has learned something. In all its wealth of discovery, it recognizes more clearly than ever before the fathomless abysses of the unknown and unknowable. It stands with unsandaled feet in the presence of mysteries that transcend human thought. Religion never so tolerant. Science never so reverent. Nearer than ever before seems the time when all souls that are loyal to truth and goodness shall find fellowship in freedom of faith and in service of love.

WM. NORTH RICE.

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*RESULTS OF THE SECOND BOTTEGÒ EXPEDITION INTO EASTERN AFRICA.**

UNDER the auspices of the Italian Geographical Society, whose President signs the preface, the survivors of the Second Bottegò Expedition into Eastern Africa have prepared and published a narrative of their arduous journey, and an account of the results achieved at the cost of two valuable lives. The volume is well written and profusely illustrated—it is, moreover, accompanied by a series of clearly drawn maps of the country traversed, much of which had been previously unvisited by European explorers.

On his second expedition Vittorio Bottegò, accompanied by three valiant assistants—Lamberto Vannutelli, Lieutenant in the Royal Navy; Carlo Citerni, of the Italian Army, and Dr. Maurizio Sacchi, left Naples on the 3d of June, 1895, and reached Brava on the Southern Somali coast on the 1st of October of that year. Ten days later the explorers marched out of Brava with a caravan of 250 Ascaris, and on November 18th reached the outskirts of Lugh, an important emporium of trade in Southern Somaliland, situated on the River Juba in about 3° north latitude, which had been visited by Bottegò on his first expedition. Lugh, it was found was

* L'Omo. Viaggio di esplorazione nell' Africa Orientale narrato da L. Vannutelli e C. Citerni. Sotto gli auspici della Società Geographica Italiana. Milano, 1899.

at that time in possession of a band of predatory Abyssinians, who of late years, as is well known, have traversed and ravaged the whole of southern Somaliland. Alarmed, however, by the reports of the advancing caravan of Italians, the Abyssinians had withdrawn leaving Lugh in ruins and completely deserted, as the native inhabitants had taken refuge on the other side of the river. Lugh lies on a peninsula of land nearly surrounded by a bend of the River Jutz, and defended by a wall some 200 meters in length which crosses the isthmus from bank to bank. The Italians were naturally well received on their arrival as deliverers from the much hated Abyssinians, and were treated in the most friendly way. After a few days they induced the population to return to their deserted city, and reinstated the Sultan of Lugh—Ali Hassan Mir on his tottering throne. A fort was built and a guard of 45 Askari left in it for the protection of the inhabitants against further invasions while a treaty of perpetual alliance between Italy and the Lughians was drawn up and signed.

Some distance above Lugh the Juba is divided into three branches—the Ueb coming from the north, the Ganula Doria from the northwest and the Daua from the west. After a month's delay, during which an excursion up the Ueb in order to restore some captives to their friends was made by some of the party, the expedition was reunited at the end of January, and proceeded up the valley of the Daua or great western branch of the river Juba, along the caravan road which leads to the region of the lakes. On the 2d of February they crossed from the left to the right bank of the Daua, and continued thence at some distance from its banks through the country of the Garra-Somali, then passing into that of the Bóran, a race of pacific shepherds speaking a Galla tongue. Leaving the water-basin of the Daua to the left, and proceeding through the hills, the party arrived on March 17th at Ascebo—a large village of from 300 to 400 houses—on the outskirts of the Bóran country. A few days later they arrived on the banks of the Bisan-Gurracia, the first water met with flowing in a western direction. Burgi, a pleasant village in the mountain of the Amarr-Bambsla, was reached on March 30th, and the tomb of Eugenio Ruspoli, an Italian explorer who was accidentally killed there some years before, was visited.

The route taken hence was northward along the Badditu range until a new lake 'never before seen by European eyes' was discovered on May 12th. Lago Regina Margherita, as it was agreed to name this fine sheet of water after the Queen of Italy, is surrounded by lofty mountains, some of which are said to attain a height of nearly 11,000 feet. Twenty-five days were spent on the exploration of this beautiful lake, which is about 250 kilometers in circumference, and lies at a height of 4200 feet above the sea-level. Just south of it, divided by low ground, is another smaller lake—Lake Ciamò, and the two together drain into Lake Stephanie, which lies some sixty or seventy miles to the southwest of them.

On June 12th, the exploration of the new Lakes having been completed and sufficient rest obtained, the explorers were ready to proceed onwards in search of the great river Omo, to trace the course of which was one of the principal objects of their expedition. It having been ascertained that the Abyssinians were in occupation of the country to the north of the new Lake, it was resolved to proceed due west through the mountains, and a most difficult task this proved to be. The path led through mountains from 9000 to 10,000 feet in altitude, and the natives were energetically hostile. But at the end of June they had traversed the range, and found themselves on the south bank of the much sought for river

which drains the southern provinces of Abyssinia. Unfortunately the Abyssinians had become well aware of their movements, and an Abyssinian Ras, Uoldu Ghirgis stood in battle array on the north bank ready to stop them. Turning away to the west through the mountains the Italians managed with great difficulty to escape their enemies, and, though hampered by constant attacks from the natives, succeeded in reaching the Omo again, and in descending its left bank to Lake Rudolf. It was thus shown that the great Abyssinian River Omo flows neither into the Nile as had been conjectured by some geographers, nor into the Juba, as had been supposed by others, but constitutes the principal feeder of the internal basin of Lake Rudolf. That a large river entered this Lake at its northern extremity was well known from former explorations. But no one had shown its identity with the Abyssinian Omo, which was thus fully established. On August 30, 1895, the Italian travellers found themselves at the north end of Lake Rudolf in occupation of the cabin of Dr. Donaldson Smith, the American explorer, who had been in the same spot about a year before them.

The chief object of the second Bottegò expedition had thus been accomplished. The Omo had been traced to its outlet in Lake Rudolf. Besides this many miles of fresh country had been traversed, and a new and most interesting lake discovered—not only discovered, but carefully measured and mapped, as will be seen by the charts attached to this volume.

Had the voyagers gone home by the usual route through British East Africa, or returned by the way they came they would have been allowed the credit of having done excellent work. But they were still ardent for further discoveries.

In the first place a side-excursion was made by Bottegò and Vannutelli to Lake Stephanie. The river Sagan, which drains Lakes Margherita and Ciamò, and which they had struck on their former route to Burgi, was found running into the head of Lake Stephanie. It was a good elephant country, and 14 elephants were killed in five days. The tusks together with the ivory previously procured were sent off to Lugh by a Somali caravan. On October 18th the whole party was again assembled at Bumé, at the northeast corner of Lake Rudolf.

Here it was resolved, on consultation, that Dr. Sacchi should proceed home via Lugh with ivory and the scientific collections already accumulated, while the remaining members of the party should continue their explorations. Dr. Sacchi reached Ascebos safely, but on returning to Lake Margherita to fetch some ivory placed in cache there, was unfortunately killed in an encounter with the natives some four months later (February 7, 1897).

Before leaving Lake Rudolf the remaining explorers resolved to make it quite certain that no river flowed out on the western side of the lake. The western bank of Lake Rudolf was, therefore, carefully examined as far south as about 3° N. L., where the river Tirgol flows from the west into the lake. Beyond this it had been already ascertained that there was no water issuing out of Lake Rudolf, which is, therefore, a closed basin, and has no connection with the Sobat and so with the Nile, as had formerly been supposed possible.

Starting again from the north end of Lake Rudolf on December 13, 1896, the travellers proposed to make their way home through Abyssinia, little aware of the unfortunate series of events which had taken place between that country and Italy. Leaving the large northeastern gulf of the lake on their right, they arrived shortly on the river Sacchi, as they proposed to name this stream after their lost com-

panion, and ascertained that though flowing directly southwards it did not at that time actually reach Lake Rudolf, but probably passed into it only by infiltration.

For ten days the River Sacchi was ascended, through a fine and fertile country, but with few inhabitants. At about 5° 30′ N. L. this river was quitted for the adjoining mountain range on the left, and after passing the water—parting at some 5700 feet in altitude a descent was made into the valley of the Sobat or strictly speaking that of the Guibà or Acobo—one of its principal southern confluents. The Guibà was reached on January 3, 1897, in about 6° 30′ S. L. and 35° E. L. It was here found to be a stream of about 200 feet in breadth and a foot and a half deep—some 30 or 40 miles from its sources in the mountain of Caffa. The descent of the Guibà was commenced on the left bank. A few days later the stream was crossed and progress was continued on the right bank some way from the stream, which was regained at Ghira, the first village in the extensive district of Jambò. Here it was found that a tongue nearly allied to that of the Shilluks of the Upper Nile was spoken, and intercourse was opened with the natives by one of the Ascari who happened to be of a native of Fashoda, but there were great difficulties about guides. Finally it was determined to proceed to the north, and another confluent of the Sobat—the Ghélo, a limpid stream running placidly westward—was reached on January 23, 1897. On attempting to descend the Ghélo the party became involved in marshes and much harassed by hostile natives, and were obliged to return to their former quarters on the Ghélo which were regained on February 6th, after serious losses in men and baggage-animals. After a few days' journey up the Ghélo, during which a new lake, proposed to be called Lake Gessi, was discovered, that river was left, and a course nearly due north was taken which brought the party after crossing several smaller affluents on the 26th of February, 1897, to the main stream of the Sobat in 8° 10′ N. L. The Sobat or (Upeno) is here a fine stream of 900 feet in width and 3 feet in depth, flowing through a fertile and thickly populated valley. Crossing the river with the assistance of the natives, which here were still of the Jambo tribe, the party continued up the right bank for several days, and then left the river to ascend the Abyssinian mountains—which border the valley on the north. Before doing this, however, a letter was sent to the Abyssinian Resident in the adjoining districts of the Sajo asking for permission to pass through his country. In reply to this some Abyssinian soldiers were dispatched to invite the Italians to come on, and to show them the way, and shortly afterwards they met Abba Cialla, brother of the Resident, Giotò di Lega, with a large *cortège* sent expressly to welcome them. On March 16th accordingly the weary travellers arrived at Jullem, near Gobo, the residence of the Desgatch, and were most cordially received. Surely now, they thought, their long tramp had come to an end and they would have an easy passage across Abyssinia to their countrymen at Cassatà. Never were such expectations more miserably disappointed. The treacherous Abyssinians made an attack on the Italian camps on the night of March 17, 1897. Captain Bottegò was killed, Citerni was wounded, and the whole of the party either slaughtered or taken prisoners. Citerni and Vannutelli were imprisoned in irons, and most shamefully abused and treated until June 13th, when orders were received from Menelek that they should be sent up to Addis Abeba. Although these orders were complied with it was not until the day of their entrance to the capital that their chains were removed. At Addis Abeba, which was

finally reached on June 22, 1897, Vannutelli and Citerni, the two surviving members of the Second Bottegò Expedition were most cordially received by the Italian Envoys—Major Nerazzini and Captain Ciccodicola, and arrangements were quickly made for their return to Europe.

Among the perils and dangers of such a journey as this especially when the great difficulties of transport are taken into consideration, the collection of scientific specimens is by no means an easy task. Yet, as will be seen by reference to the Appendix to the present volume, the members of the Second Bottegò Expedition by no means neglected this part of their duties. After the geological, meteorological, and astronomical observations are given we find a summary of the zoological results prepared by Dr. Gestro of the Museò Civico of Genoa. These are based on specimens obtained during the first part of the journey between Brava and Lake Rudolf which, however, formed but a very small proportion of the whole collections. The Mammals have been described by Mr. Oldfield Thomas of the British Museum in two papers published in the Annals of the Museò Civico of Genoa, the first relating to 27 species and the second to 20, one of which (*Crocidura bottegi*) was new to science. The few birds saved from the wreck have been named by Count Salvadori, the Reptiles and Batrachians by Mr. Boulenger and the Fishes by Sigo Vinciguerra. Their reports have likewise appeared in the same well-known periodical. The more numerous specimens of Invertebrates have been worked out by various specialists of whose contributions the titles are given here, together with an abbreviated account of the principal novelties accompanied by many excellent illustrations. The value of this well prepared volume is further enhanced by the excellent series of maps attached to it, whereby every detail of the routes pursued may be followed with the greatest ease. The name of Giacano Doria attached to the preface is a guarantee that neither trouble nor expense has been grudged in the production of the present volume as is indeed at once evident to all that examine it.

P. L. SCLATER.

LONDON ZOOLOGICAL SOCIETY.

ON THE CHEMICAL NATURE OF ENZYMES.

THE enzymes form one of the most interesting groups of organic compounds from the physiological as well as the purely chemical point of view. Physiologically they may be classified as follows:

1. Enzymes which are intimately connected with nutrition, as diastase, pepsin, trypsin, lipase, etc.

2. Enzymes which cause oxidations—the oxidases.

3. Enzymes which bring on coagulations, the clotting enzymes: rennet, thrombase, pectase.

The first group has been known longest and best and has served certain authors for inferences and distinctions which at present are no longer tenable. Erroneous views as to the rôle of enzymes are however now and then entertained even at the present day, actions being ascribed to them which belong exclusively to the living protoplasm itself. Thus, in an article on 'Assimilation and Heredity' the hypothesis was formulated that "enzymes are the true bearers of heredity." Thus far it has been the well founded inference that the molecular arrangement, the invisible organization or tectonic of the chromosomes forms the foundation of the genetic differentiation and heredity. These chromosomes consist principally of a nucleoproteid (chromatin) of a very labile nature, that is easily converted into a stable proteid by injurious influences which cause their death. The chromatin of the chromosomes of different animals may not be identical, but only iso-

meric, or otherwise closely related (something chemically very difficult to prove), but there can be no doubt that the *tectonic* must be a different and a specific one in the chromosomes of every different kind of animal. This different construction or machinery causes those special differentiations in the further development of a fecundated egg which characterize a species,* while it is the chemically labile nature which confers the power of transforming and applying energy.

Moreover, the same author ascribes to enzymes the power to form living matter from the dead matter of the food. This, too, is not correct. The proteolytic enzymes merely provide the living animal cell with soluble protein (albumoses), but this inactive protein is converted into living matter by the living protoplasm itself (probably by the nucleus), but surely not by enzymes.

Besides the known enzymes that act on glucosides, carbohydrates, fats and true proteins, there exist certainly still others of however a rather narrow sphere of activity. Certain mites and a few fungi attack hair and horn and utilize therefore keratin as food, hence, they must be able to prepare an enzyme (keratinase), especially adapted to dissolve keratin. Certain fungi easily perforate the chitin structures of insects and a special enzyme (chitinase) has to be assumed also in this case. Still another group are the but recently recognized *bacteriolytic* enzymes, produced by certain kinds of bacteria themselves. These enzymes play an important rôle in the recovery from and immunization against infectious diseases.† Their powers of dissolving bacteria, however, are restricted to certain kinds and may in many cases act on one kind only. It is from the ecological standpoint certainly a remarkable fact, that an organism, as, *e. g.*, *Bacillus pyocyaneus* produces an enzyme which, after reaching a certain concentration, dissolves the bacillus itself! The bacillus, so to speak, commits suicide by means of its own enzyme—certainly not a teleological working of nature for the maintenance of species!

As to the *chemical nature* of enzymes three questions above all have occupied the mind of investigators, viz.: 1. Are the enzymes proteins or not? 2. How is the fact to be explained that a very small amount of an enzyme can transform a relatively very large amount of another compound? 3. What is the cause of their quite specific action, the reason that they can only attack a specific compound and not others, even closely related ones?

The importance of the first question has been much overrated and while one author asserted they belong to the coagulable albumins, another ascribed to them the nature of nucleoproteids and still others claimed that enzymes are very different from any protein matter. It is true, special difficulties are encountered in the purification and isolation of enzymes, but it is also not less true, in many cases at least, that it is quite impossible to separate the enzymic activity from protein matter. The tendency of certain authors to infer from the nature of *one* enzyme the nature of all the others also, is not justified at all. There may exist enzymes in every group of proteins, and some may exist that are not proteins, although derived therefrom.

Wurtz* has recognized papayotin, the proteolytic enzyme of Carica papaya as an albumose and Chittenden† thinks the di-

* The various hypotheses treating this problem have been discussed by Ives Delage: *La structure du protoplasma et les théories sur l'hérédité, etc.* Paris, 1895.

† Cf. Emmerich and Loew, Bacterolytische Enzyme als Ursache der erworbenen Immunität und die Heilung von Infections krankheiten durch dieselben; Zeitschrift für Hygiene, Vol. 31, May, 1899.

* *Comptes Rendus*, 90, 1379.

† *Transactions of the Conn. Acad. of Sciences*, Vol. 8 (1891).

gesting agent of the pineapple to be of the same nature. Pelkelharing* found that the activity of pepsin is intimately connected with a nucleoproteid and the same author as well as Halliburton declare thrombase (the clotting enzyme of the blood) to be a nucleoproteid.† Spitzer declared also the peroxidase of the animals to be a nucleoproteid,‡ which however, the writer found not to be the case with the vegetal peroxidase, which in all probability has an albumose-like nature. Seegen and Kratschmer§ inferred from their investigations an albuminous nature of the diastase of the liver, while the writer found the trypsin and diastase of the pancreas gland to be of peptone character; that is to say, when transformed to the *inactive state*, they behave towards the usual reagents like a peptone, while in regard to their *activity* they differ essentially from them (see on this point further below). As to the diastase of malt, Osborne as well as the writer,|| has inferred its protein character. In the purest state it was prepared by Wróblewski, who showed that it was a proteose and was formerly obtained with an admixture of a carbohydrate, araban. This author recently also proved invertase to be of a proteose or peptone-like nature. Certain authors failed to obtain with their enzyme preparations either the reactions or the composition of protein matters, which may have been due in some cases to imperfect purification, while in others the enzyme might really be no protein at all, which is probably the case with the rennet, investigated by Hammarsten. The *active* character of an enzyme is not necessarily connected with a protein nature, since the ordinary soluble proteins have no such activity at all. In analyzing enzymes we can only find the composition of the *killed** enzyme, which in fact is no longer a real enzyme. This brings us to the second of the above questions, the cause of their chemical powers. The question how it is to be explained that a small amount of enzyme can transform a relatively very large amount of another substance has been answered in various ways, none of which have proved satisfactory. We shall not enter here on a critical review of all these hypotheses, which the reader will find treated in Green's recent work: 'The Soluble Ferments and Fermentation,' (chapter 24).† Only a few points, especially regarding recent views may be mentioned, before the view of the writer is discussed.

One author declared that enzymes are not bodies, but properties of bodies (which nonsense was called by several authors an 'ingenious,' hypothesis!); another said that small quantities of enzymes are merely attached to proteins, but are not proteins themselves; another declared that the enzymes act by repeatedly causing oxidation and reduction.‡ But even if this last mentioned view were correct (which cannot be, since most enzymes can be active also in the absence of oxygen), it does not explain the power that would cause the supposed oxidations and reductions. Saccharoff, who advanced this hypothesis, made experiments with papayotin only, in which he assumes a small quantity of 'bionuclein,' an active principle, containing iron, and associated with it a larger amount of another substance that has a mere promoting action. From some very vague

* *Zeitschrift physiol. Chem.*, Vol. 22, p. 233.

† *Arch. für Physiol.*, 1895, p. 213, and *Journal of Physiol.*, Vol. 9, p. 265.

‡ *Jahresbericht f. Thierchemie*, 1897.

§ *Jahresbericht f. Thierchemie*, 1877.

|| *Pflüg. Arch.*, Vol. 27, p. 206.

* The word 'killed' is used here as a short term for 'transformed to an inactive state.'

† Recently a review of this work was published in this JOURNAL.

‡ *Saccharoff, Centralbl. f. Bakteriologie*, Vols. 24. and 26.

trials this author draws far-reaching conclusions and even ascribes all actions of living protoplasm to the presence of an exceedingly small quanity of 'bionuclein,' present in albuminous matters of the cells.

The writer in 1882 proposed the view that enzymes are like the protein bodies of the *living* protoplasm distinguished by the presence of *chemically labile atomic groups* * and said at that time: "it seems as if some remnant of the active powers of the protoplasm must be contained in the enzymes." Later on, somebody else called enzymes 'protoplasm splinters' and since then this phrase has been echoed by many who did not conceive or concede that the principle common to both consisted in chemical lability.

The principle of chemical lability (instability) has thus far been but little studied. The writer has recently suggested the desirability of distinguishing between kinetically-labile and potentially-labile compounds.† A *kinetically labile compound* is characterized on the one hand, by the easy change to a more stable, isomeric or polymeric modification or compound, and on the other, by the great facility with which it enters into reactions with various other compounds, especially with such as also possess labile properties, whereby result products with a less degree of instability. *Potentially labile* compounds behave differently, they do not pass into isomeric or polymeric modifications, do not easily yield various derivatives, but are inclined to sudden far-reaching decomposition or explosion. Examples of the former class are aldehydes, amido-aldehydes, amido-ketones; of the latter class, the diazo-compounds and the nitrates of polyvalent alcohols as nitroglycerol. Kinetic lability comprises free chemical energy while potential lability intra-molecular chemical energy of position to be well distinguished from the potential energy relatively to oxygen, a potential energy present in all organic compounds and liberated in the act of combining with oxygen.

Chemical energy consists in certain motions of atoms, motions of larger amplitudes than the motions of heat energy, although easily passing into the latter. We must infer the larger amplitudes of chemical energy from the fact that at the ordinary temperature the chemical energy can counteract the force of affinity in a much larger measure than heat energy can do it.

Free chemical energy in a labile compound is caused by a loose position of atoms in certain atomic groups, and this loose position is the consequence of a depression of affinities on account of one atom being under the simultaneous influence of two neighboring atoms. Such atoms in loose position are subjected to much more violent oscillations under the influence of heat energy than are the other atoms in stable position in the same compound. Thus, heat energy is easily transformed into chemical energy by labile atomic groups. As the writer first pointed out, such machines to transform heat into chemical action are, *the proteins of the living protoplasm* and *also the enzymes*, the latter, however, in a much less degree than the former.

The organized proteins of the living matter produce their own heat by respiration, whilst the enzymes utilize either the free store of heat energy in the atmosphere when they act at the ordinary temperature, or also the heat of other sources when they act at an elevated temperature.

Let us now review the general chemical

**Pflüger's, Archiv*, Vol. 27, p. 211. Also, *Journal für praktische Chemie*, Vol. 37, p. 103.

†A detailed account of this view, explained by numerous examples is contained in Chapter 11, of the treatise of the writer: "Der chemische Energie der lebenden Zellen," recently published in Munich by Dr. E. Wolff.

properties of enzymes. Although an increase of heat up to a certain point (the optimum temperature) promotes their actions, a further rise in temperature is injurious and a still further rise stops all their actions. This is in perfect accordance with the transition of a labile to a stable modification, or even to a still more different compound, produced by atomic migrations. The labile atoms approach by their larger oscillations too closely to other atoms, the affinity of which can exert now sufficient power to produce an 'atomic migration.'* The enzymes are 'killed' at this fatal degree of intensity of heat, in other words they have lost their labile, unstable atomic groups, by 'migration' of atoms into a stable position; lability and activity cease to exist. In further analogy to many cases of transformations of labile into stable compounds, enzymes are also 'killed' by a certain amount of alkalies or acids. Different enzymes are resistant in very different degrees, however, not only to these agencies but also to other injurious compounds. This indicates either differences in the *nature* of the labile atomic groups or, what appears more probable to the writer, different positions of the labile groups within the molecule. The closer to each other they are situated, the more easily the transformation to an inactive isomeric compound will take place. The greater the intensity of chemical energy at a given temperature the more activity is possible, and the more easily the point of destruction is reached.

It seems highly probable that there exist two or even more labile groups in one molecule of an enzyme, since Jacobson observed that by a cautious application of heat their power of decomposing hydrogen peroxide may be taken away, while their specific enzymatic action may be retained.*

A few instances will illustrate the differences of resistance of enzymes: trehalmse is killed at 64° C., while inulase at about 70°, emulsian at 75–80°, diastase at 80–86°. The temperatures, however, vary considerably with the acid or alkaline reaction of the liquid, with the degree of concentration and with the presence of neutral salts, or of some organic neutral compounds. Furthermore, while pepsin resists at the ordinary temperature 2 per mille hydrochloric acid, trypsin, emulsin, diastase and papayotin are killed by less than 0.5 per mille.† On the other hand, pepsin is more easily destroyed by sodium carbonate than trypsin and rennet. Invertin is very easily destroyed by dilute alkali (Wróblewski). Hydrogen sulphide easily kills the proteolytic enzyme of *Micrococcus prodigiosus* and *Proteus vulgaris*, not, however, that of *Bacillus Milleri*, nor pepsin, diastase or emulsin.‡

The writer has observed that prussic acid of 25 per cent. kills diastase (but not trypsin) at the ordinary temperature within 12 hours. Arsenious acid is reported to have no injurious effect upon enzymes, but in the writer's opinion this question deserves further study. Certain alkaloids have also been observed to have a destructive action on enzymes. Quinine, 1 per cent. has an inhibitory effect on the action of

* Organic chemistry abounds with interesting cases of this kind. Even the first synthesis of an organic compound, that of urea from ammonium cyanate, is due to such an interesting transformation.

* *Zeitschrift f. physiol. Chem.*, Vol. 16, p. 340 (1892). Bourquelot assumes here the presence of an impurity with certain active properties which agrees with some recent tests of the writer.

† Organic acids act less energetically. Thus Wróblewski reports that invertin can resist even 4 per cent. acetic acid for some time.

‡ Cf. Fermi, *Archiv. f. Hygiene*, Vol. 14, p. 15. *Chem. Centralbl.*, 1894, I., p. 965. The writer has convinced himself that neither basic acetate of lead nor hydrogen sulphide, when applied for a short time in moderate quantities, injure diastase or trypsin, and therefore Wurtz's method may well be applied for the preparation of these enzymes, especially from the pancreas gland.

pepsin, while it does not injure diastase or oxidase. Atropine in moderate quantities makes diastase inactive.* Further, prolonged contact with alcohol injures the enzymes more or less.

The writer long ago tried to solve the question what kind of labile atomic groups cause the activity of enzymes, and had certain reasons for the supposition that the lability is due to the simultaneous presence of aldehyde and amido-groups in the molecule of an enzyme. Indeed amidoaldehydes (and amido-ketones) exhibit a high degree of lability. The usual tests for aldehyde groups failed however, but it may nevertheless be possible that these are present in the less active polymeric form.† It deserves to be mentioned in this connection that free hydroxylamnie which very easily enters into reaction with aldehyde groups, also renders diastase inactive in a diluted neutral solution. In regard to labile *amido-groups* it is to be expected that enzymes containing them would become inactive as soon as certain compounds combine with the amido-groups and change them. Such a substance is formaldehyde. Indeed, pepsin and diastase are rendered inactive when they remain for 24 hours in contact with a neutral solution of 5 per cent. formaldehyde. Other enzymes, as emulsin, papayotin, trypsin, etc., yield in its presence inactive precipitates.‡ These observations were later on, made also in the Institut *Pasteur* without, however, any attempt to draw a further inference. In the opinion of the writer however, this behavior makes the presence of labile amido-groups highly probable.

If we now take into consideration the fact that the study of the cleavage products, obtained by boiling with acids or alkalies, or the elementary analyses, can only clear up the composition of the *killed enzymes*, while it leaves us completely in the dark as to the nature of the labile active groups in the original enzymes, we must feel surprised at the attempts to find by simple analysis the true nature of the chemical power of enzymes.

The denial of the protein nature of enzymes on the ground that they are more easily changed by injurious influences than are the proteins is also a source of surprise. Several passages may here be quoted to show the opinions of recent physiologists. Thus we find in an article by a German physiologist the following passage: "There is no reason to doubt that as soon as an analysis of the enzymes has been accomplished, their synthesis will be accomplished too." And in a recent work of an English physiologist we read: "Some serious objections to the view that enzymes are proteids can be based upon the action of light upon them. Diastase is injured by direct sunlight, proteids are not." *Both these views are unqualifiedly erroneous.* Enzymes of protein nature are not ordinary passive proteins, but proteins with labile atomic groups. Only the changed (*killed*) enzymes can be classified with the *ordinary* proteins.*

As soon as we understand the close connection between lability and activity, and that enzymes are capable of transforming heat energy into chemical energy, we can also by means of Helm's principle of the intensity of energy understand that their chemical energy may be transferred to other compounds. And when these other compounds are of such a character that

* Detmer, *Landwirthshaftliche, Jahrbücher*, 1881.

† Nencki and Macfadyen observed with one enzyme only, viz., one derived from the cholera bacillus, a reduction of an alkaline silver solution (1891), while Brieger obtained a phenylhydrazone with a protein contained in a culture of the microbes of diphtheria.

‡ O. Loew, *Journ. f. prakt. Chem.*, Vol. 37, p. 704 (1888).

* The writer makes use of the proposed distinction between *protein* and *proteid*. Protein is the general name for all protein matter, while proteid signifies exclusively the more complicated kinds containing phosphoric acid, sugar, etc. (nucleins, mucins, etc.).

their atoms are easily set in motion, we can further understand that, by thus lessening certain affinities in them, another grouping of atoms may result.

It thus becomes intelligible why one molecule of an enzyme can, like a machine, change innumerable molecules, one after the other, of another compound. The chemical changes produced consist either in depolymerization, as in the production of dextrin from starch, or in hydrolytic action, as in the conversion of maltose into glucose, or in a further splitting combined with atomic migration, as in the production of amido-acids and bases from protein by trypsin.

Such chemical action produced by the mere transmission of chemical energy by a certain substance, which remains chemically unaltered, but acts like a machine, are called *catalytic*. We know that such actions are produced by finely divided metals, by alkalies and strong acids and that such are also produced by labile organic compounds. Thus, for instance, an aqueous solution of ethylaldehyde transforms dicyanogen rapidly in oxamid without undergoing a change itself (Liebig). Finely divided nickel splits acetylene into carbon and hydrogen,* finely divided platinum splits hydrogen peroxide into water and oxygen, etc.

We may now consider the third of the above questions: *How can the specific action of the enzymes be explained?* How is it, for example, that diastase can saccharify starch but not inulin, that inulase can saccharify inulin but not invert cane-sugar, that invertase can invert cane-sugar but not milk-sugar? Here the principle of the configuration of the molecules comes in. The closer the contact, the more perfect a transmission of energy is possible. The molecular adhesion, however, is enhanced by a certain coincidence of the surface features of the molecules. The writer in the year 1893 applied this principle to explain the fact that certain alkaloids have in very small quantities an effect only upon certain nerves, but not on all nerves, nor upon glands or muscles.* Later on, E. Fischer applied the same principle to the specific action of the enzymes, adopting the comparison to lock and key. However, *Fischer did not discuss at all the question* how enzymes can develop their energy nor did Green in his recent work: 'Soluble Ferments' devote a single line to it. The action of enzymes might be distinguished as *enzymations* to separate them from true fermentations which are such actions of bacteria as are intimately connected with, and directly dependent upon their living protoplasm itself and not upon enzymes secreted. From the recent observation of Eduard Buchner that alcoholic fermentation is not directly connected with the life of the yeast cell, it does not necessarily follow that lactic, butyric, or acetic fermentations are mere enzymations. Besides this, A. Wróblewski† has in a recent very interesting article pointed out important differences between zymase and the ordinary enzymes. The expressed juice of yeast is always *opalescent* and loses its fermentative action when filtered perfectly clear. It further soon loses its action upon mere dilution with water and also upon addition of $1\frac{1}{2}$ per cent. of neutral salts. Formaldehyde, as well as sodium nitrite destroy the activity of zymase more easily than that of the true enzymes. Twenty per cent. ethyl alcohol destroys the zymase but not yet the known enzymes.

OSCAR LOEW.

U. S. DEPARTMENT OF AGRICULTURE,
WASHINGTON, D. C.

* Moissan and Moureu, *Compt. Rend.*, Vol. 122, p. 1240.

* A natural system of poisonous actions, Chapter VI., Munich, 1893, Dr. E. Wolff, publisher.

† *Centralblatt für Physiologie*, September, 1899. He also showed that white diastase can be precipitated by saturation with sulphates, invertase can not.

ASTRONOMY IN THE FIRST HALF OF THE NINETEENTH CENTURY.

DURING the first half of the present century the most eminent astronomers, Karl Friedrich Gauss, Friedrich Wilhelm Bessel and Friedrich Georg Wilhelm Struve, were natives of Germany. Gauss was born in 1777 at Braunschweig; Bessel in 1784; Struve in 1793 at Altona. All three were also mathematicians, but of various mathematical ability; in Struve's case his reputation in the higher mathematics was subordinate to that as an astronomer. Gauss was one of the first mathematicians of his age, and perhaps of any time. Bessel was celebrated by his success in the most difficult problems of mathematical astronomy, as well as in the practical handling of instruments, and as a teacher of the science.

Gauss's early ability as a calculator was enough to render him conspicuous in the circle of his friends, and to stimulate his relatives, people of humble station, to make every exertion for his education. He received the degree of doctor of philosophy at Göttingen at an early age, and became professor of astronomy there. His earliest mathematical work was the 'Disquisitiones Arithmeticæ,' in which he inserted the brilliant discovery that a regular polygon of seventeen sides can be inscribed in the circle by ruler and compasses without the use of any means but those allowed by Euclid. When still a young man of twenty-four, he became widely known as an astronomer, by the rediscovery of the small planet Ceres. This had been discovered by Piazzi, and observed only a short time. After this time it was lost in the rays of the sun, and no other astronomer was able to calculate its position with sufficient accuracy to find it again, as proper formulæ were wanting in the astronomical periodicals. These formulæ Gauss possessed, and they solved the problem, and the asteroid was readily found by the results of his calculations as a star barely visible to the naked eye. As professor at Göttingen, he lived to a venerable age. Among his students was our eminent countryman, Dr. B. A. Gould. Gauss fitted up the observatory with the best instruments of the time, and his works have not yet been published in full sufficiently to content his surviving disciples.

Bessel, seven years younger, was born at Minden; and his early education was in the counting house of Messrs. Kulenkamp at Bremen. He soon found astronomy more interesting than business and became well known amongst specialists in that science. In 1814, he was made a professor and director of the observatory in the rising university of Königsberg, which soon became celebrated as the place where Bessel lived. Every effort was made to keep the young institution at the height of astronomy as then known. He lived there till 1846, when he passed away at the premature age of sixty-two, after many striking achievements, among which is especially conspicuous the first satisfactory measure of a star's distance from the solar system. He showed that 61 Cygni was more than five hundred thousand times* the sun's distance, or between forty and fifty millions of millions of miles from us.

Gauss lived till 1855 and died at the venerable age of seventy-eight, 'full of age and honors.' His younger friend, W. Struve, was the son of the head master at Altona, whose special department was philology. He received his early training in astronomy at Dorpat, where his ability as a calculator attracted the attention of Huth, then professor there of mathematics and astronomy. Huth allowed him to use the observatory freely. He received his first instructions in the use of instruments from the 'Observator' Paucker. After

* In treating this star I have used later figures than those of Bessel.

Paucker went to the college at Mitau, Struve obtained the degree of doctor of philosophy there and was soon made 'Observator' at Dorpat, where he remained a quarter of a century as professor. During his professorship at Dorpat he prepared lectures on the transit instrument, which were translated into French by a pupil, Lieut. Schyanoff, and are still an admirable textbook. Struve's ability attracted the attention of Tsar Nicholas I., and in obedience to his orders, Struve built and furnished the great central observatory at Pulkova, a suburban village near St. Petersburg. For the instruments he consulted the best mechanicians in Europe, especially the firm of Repsold of Hamburg. The observations at Pulkova were of the highest possible accuracy and were continued till Struve himself had retired from active service and had been succeeded by his son, Otto Struve, one of his most faithful students and an admirable observer. He died in 1864, and left the reputation of a scientific man, who had accomplished great results for the geography of his adopted country, and was one of the most practical astronomers of the present century.

George Biddell Airy, born in 1801, and surviving till 1892, was chiefly remarkable for the business-like routine which he introduced into the royal observatory at Greenwich, and for the example which was then set to less able astronomers of the manner in which they might conduct extensive operations connected with the vast study of the universe.

The writer considers himself not mistaken in assigning the position of astronomical science during the first half of the nineteenth century to the four philosophers mentioned in this brief paper, viz.: Gauss, Bessel, W. Struve and Airy.

TRUMAN HENRY SAFFORD.

WILLIAMS COLLEGE.

*THE ELECTRIC FISH OF THE NILE.**

THE lecture dealt almost exclusively with the formidable fish found in the rivers of North and West Africa, *Malapterurus electricus*.

Photographs were shown of the drawings upon the interior of the tomb of Ti, showing that the fish was recognized as remarkable by the Egyptians five thousand years before the Christian era. Living specimens of the fish were also displayed, these having been given to the lecturer, for the purpose of illustrating the lecture, by the authorities of the Liverpool Corporation Museum.

The structure of the electrical organ was then described. It is situated in the skin enclosing the whole body of the fish, and has a beautiful and characteristic appearance when seen in microscopic sections. Each organ consists of rows of compartments, and each compartment has slung athwart it a peculiar protoplasmic disc shaped like a peltate leaf, with a projecting stalk on its caudal side. Nerves enter each compartment, and end, according to the recent work of Ballowitz, in the stalk of each disc. By these nerves nervous impulses can reach the organ; the arrival of such impulses at the nerve terminations evokes a state of activity which is associated with the development of electromotive charges of considerable intensity constituting the organ shock. The shock is an intense current traversing the whole organ from head to tail and returning through the surroundings; it stuns small fish in the neighborhood and can be felt by man when the hand is placed near the fish, as a smart shock reaching up the arms to the shoulders.

Recent investigations made by the lecturer at Oxford in conjunction with Mr. G. J. Burch were next described. These comprised a large series of photographic records of the displacement of the mercury of a

* Abstract of a lecture before the Royal Institution of Great Britain.

capillary electrometer in consequence of the electrical disturbance in the organ which is 'the organ shock.' A number of these records were exhibited; they showed the time relations, mode of commencement and manner of subsidence of the shock, and demonstrated its similarity to the electrical changes known to exist in nervous tissue during the passage of a nervous impulse. A remarkable feature of the organ shock as distinct from the phenomena of nerve was then brought forward. The shock even when evoked by a single stimulus was shown to be rarely if ever a single one. Each effect consists of a rhythmical series of electrical changes occurring one after another in a perfectly regular manner at intervals of $\frac{1}{100}''$ to $\frac{1}{300}''$, the rate depending upon the temperature. By special experiments it was shown that this rhythmical series is due to self-excitation, each change producing an electrical current of sufficient intensity to excite the nerves of the tissue in which it was generated. It follows that only the initial member of the series need be evoked by nervous impulses descending the nerves, since the others must then ensue. The potency of the organ as a weapon to be wielded by the fish is thus enormously increased by its resemblance to a self-loading and self-discharging automatic gun. The total electromotive-force of the whole organ in a fish only eight inches long can reach the surprising maximum of 200 volts, at any rate in the case of the initial shock. The attainment of this maximum is due to the simultaneous development of perfectly similar electromotive changes in each of the two million discs of which the organ is composed. In a single disc the maximal electromotive force only amounts to from .04 to .05 volt, and since in a small nerve an electrical change of .03 to .04 volt has been observed, the large total effect is not due to any extraordinarily intense electrical disturbance in each tissue element, but to the tissue elements being so arranged that the effect in one augments those simultaneously produced in its neighbors.

Finally, the remarkable characters of the nervous connections of the organ were described. Each lateral half of the organ, although it has a million plates receiving nerve branches, is innervated by one single nerve fiber and this is the offshoot of a single giant nerve-cell situated at the cephalic end of the spinal cord. The structure of this nerve-cell was displayed by means of microscopic sections and by wax models made by G. Mann, of Oxford. As regards the nervous impulses which the fish can discharge through this nerve-cell, experimental results were described which show that the fish is incapable of sending a second nervous impulse after a preceding one until a period of $\frac{1}{10}$ second has elapsed, and that this interval is rapidly lengthened by fatigue to as much as several seconds. The inability of the central nervous system to repeat the activity of the organ obviously presents disadvantages to the use of the shock as a weapon for attack or defence, but such disadvantage is more than counterbalanced by the property of the organ alluded to in the earlier part of the lecture, viz., that of self-excitation, since a whole series of shocks continue to occur automatically in rapid succession provided that an initial one has been started by the arrival of the organ of a nervous impulse sent out from the central nerve-cell.

FRANCIS GOTCH.

SCIENTIFIC BOOKS.

The Elements of Alternating Currents. By W. S. FRANKLIN and J. WILLIAMSON. New York, The Macmillan Company. 212 pages.

This book gives an exposition, or rather introduction into the engineering methods of investigation, that is, those methods which are used in practice to investigate the phenomena taking place in alternating circuits, and to design alternating apparatus.

The contents of the book are:

Chapters I. to IV., General Principles of Alternating Waves and Measurements.

Chapters V. to VII., Inductive Circuits, Parallel and Series Connection.

Chapters VIII. to XV., Alternators, Transformers, Synchronous Motors, Converters, Induction Motors, Transmission Lines.

The book is based on college experience and intended as a text-book for colleges, and fulfills this object admirably, better than any other book on these subjects that I know, not only by what it gives but also by what it omits. It does not give design of alternating apparatus except in a few isolated cases, which would preferably have been omitted also. The designing data and methods in the present state of the electrical industry form one of the most valuable assets of a few large manufacturing companies, and thus are practically inaccessible to the public, so that any book claiming to teach design of alternating apparatus can immediately be recognized as an intentional or unintentional fraud.

In electrical engineering, as in most branches of science, two methods of investigation exist. The *differential method* compounds the equations of the phenomena taking place in the time differential. It is the only exact method, and the method which has given broad results of universal importance in the hands of men such as Maxwell and Heavyside, but in the hands of anybody but a mathematical genius, this method is absolutely barren of results. In engineering practice to integrate the differential equations, such assumptions have to be made that ultimately the result, derived by excessive labor, applies to phantom apparatus only, as a hysteresis-less transformer, or an induction motor without self-induction, or any such monster.

In the *integral method*, the time differential and to a large extent, the time as variable has altogether disappeared, the alternating wave is represented by its quadratic mean and its phase, the E.M.F of self-induction finds its expression in a constant ohmic reactance, and even the hysteretic loop has disappeared and is represented by an angle of advance of the phase of magneto-motive force with regard to the magnetic flux.

This method is naturally an approximation only, and after the problem has been solved the results have to be discussed regarding their accuracy, and corrections applied to allow for secondary effects, as higher harmonics, etc., just as in astronomy the preliminary orbit of a comet has to be corrected for the disturbances caused by the planets.

But the integral method is the only method which is of practical utility, whether as graphical or trigometrical, or symbolic treatment in complex quantities.

Unfortunately in our colleges, usually, too much preponderance is still given to the differential method, starting from Green's theorem and leading into the nowhere, and further time wasted by spreading misinformation in the attempt to teach apparatus design, although, fortunately, a reaction is setting in now by replacing the teaching of apparatus design by that of a thorough understanding and study of the actions and internal reactions of the apparatus, and differential methods by engineering methods.

I believe, however, that these differential methods might better be dropped altogether from the curriculum of our colleges, and the time saved thereby distributed between the teaching of engineering methods, for which the above discussed book forms a very suitable text-book, and is especially intended, and differential calculus pure and simple, endeavoring in the latter to give the student a thorough understanding and intuition into the fundamental principles rather than to load his memory with a lot of useless, because immediately forgotten, formalism. There appears to me no branch of science more tedious than mathematical physics. Mathematically, it has neither the interest nor the elegance of pure mathematics, and physically, it is, with very few exceptions, barren of results.

CHAS. P. STEINMETZ.

Kinematics of Machinery. By JOHN H. BARR, M.S., M.M.E., Professor of Machine Design, in Sibley College, Cornell University. New York, Wiley & Sons. London, Chapman & Hall. 1899. 8vo., pp. v + 247, 213 illustrations, cloth. $2.50.

Professor Barr has placed within reach of the teachers of the subject a concise, yet, within its range, very complete and a very admirably planned and well-written, treatise on kinematics. The book is the outcome of a number of years experience in the methods of instruction adopted, and, privately printed, has been kept under revision until it was thought sufficiently well settled as to form and extent to justify its more general use. These years of experience in class-room work before publication insure the elimination of probably substantially all those inevitable errors of omission and of commission which mark a first edition of practically all works not thus first well pruned out in advance. The substance of the book consists of a clear and concise presentation of those main principles which find most frequent and general application in the work of the designing mechanical engineer; it is a work of application rather than an attempt at complete and purely scientific development.

The systems of treatment and application are standard with the engineer and follow the best authorities wherever practicable, and credit is frankly given to Willis, Rankine, Reuleaux, Kennedy and others, in all departments.

The discussions of fundamental concepts, methods of transmission of motion, gearing, cams, linkwork and wrapping connectors, are all excellent and the treatise gives internal evidence of preparation by an author practically as well as theoretically familiar with his subject. There is presented just such a combination of the purely scientific with the applied science of kinematics in mechanical engineering as is now in most general demand among the technical departments of our colleges and universities. At its close is appended a very useful collection of exercises and problems in illustration and application of the principles enunciated in the body of the text. Such a collection of examples has been much needed in this subject and its preparation reflects great credit upon Professor Brügel, who supplied the greater part of this division of the work, and entitles the author of the book to hardly less credit for his good judgment in making use of them.

The illustrations are well-chosen, well-made and well-printed, and the book, as a whole, is a very excellent piece of book-making and a credit alike to author and publishers.

R. H. THURSTON.

Darwinism and Lamarckism, Old and New. By FREDERICK W. HUTTON, F.R.S., etc. New York, G. P. Putnam's Sons.

This book embodies some four lectures, in which are discussed the general subject of evolution and, as indicated in the title, its Darwinian and Lamarckian aspects. Delivered at rather widely separated intervals from 1882 to 1898, they naturally lack somewhat in that continuity of thought and treatment desirable in a series of consecutive chapters. The author's apology for "adding to the already voluminous literature on Darwinism is that the subject is always advancing, and any attempt to convey that knowledge in simple language can hardly fail to do good, provided it be sufficiently clear to be understood at first reading, and sufficiently short to discourage skipping." His purpose is confessedly that of the expositor, and his treatment of the subject is generally directed to that end. At times, however, he assumes the attitude of the advocate, sparing no pains in using favorable evidence to the best possible advantage, and discounting that of an opposite character in corresponding measure.

A brief introductory chapter is devoted to the correction of certain misconceptions of Darwinism and answering objections urged against it, which, though old, are constantly being reiterated, as, for instance, the strictures of Lord Salisbury in his presidential address before the British Association in 1894. He also refers to evident advances which have taken place in biological thought within recent years, following his earlier lectures on the subject, notably the discussion of acquired characters, and to a less extent concerning social evolution. The concluding pages of this chapter he devotes to a discussion of 'The Objects of Evolution,' in which there are apparent certain teleological aspects and tendencies of a somewhat antiquated type; as, for instance, when he undertakes to show special design in the presence of gold, silver, lead, zinc, etc., which, but for the presence of man, could have had no place in the economy of nature! To say that "not only

were these made for man, but they appear to have been made as rewards for the exercise of his intellect," may satisfy the inquisitions of the author, but it may be quite an open question as to its conclusiveness to the intellect of the average Darwinian. Similarly, when he proceeds to say "There are other substances, such as the rarer elements of which no use seems ever likely to be made, except the important one of stimulating inquiry"; he can hardly be said to materially contribute to the elucidation of Darwinism or Lamarckism, *new* or *old*.

The first lecture on Darwinism, while a fair summary of the general subject, is less a critical exposition of the essentials of his subject than a comparison with the main points in the theory of Lamarck, and of limitations to the theory. The second lecture, purporting to set forth the distinctive features of the 'The New Darwinism' is, however, very unfortunate in that it strangely confuses Neo-Darwinism with those special contributions made by Gulick and Romanes, the factors of isolation and physiological selection. For example, on page 84 the author says: "The Neo-Darwinians accept Darwin's teachings, and supplement the theory of natural selection with methods of isolation, which had been either overlooked or had not been brought into sufficient prominence by Mr. Darwin." It certainly can hardly comport with clearness of exposition to confuse these contributions, valuable as they may be, with those of Wallace, Weismann and others, which have given rise to the phrase Neo-Darwinism, and established it as an integral element of recent Darwinian literature. This oversight can hardly be attributed to any lack of acquaintance with the subject, for he makes frequent reference to it. It is, however, none the less unfortunate, and renders the entire lecture more or less misleading to the class of readers to whom it is specially directed.

In the chapter devoted to 'The New Lamarckism' the author is more fortunate in this respect, properly distinguishing the principles and representatives, and their special contributions to the subject. Upon the whole the discussion is good, though, as elsewhere suggested, he at times assumes the position of the advocate rather than the expositor. And yet, strangely enough, his final summary would seem to commit him to at least a quasi indorsement of the very principles he has been so ardently criticizing. For example, on page 215 he says: "It is generally allowed that children sometimes have the habits of their parents. This may occasionally be due to imitation, but I think not always. The jerking movements of the tails of many birds, and the side movements in that of the wagtails, are probably inherited habits, for they do not appear to be of any use. * * * If habits and instincts which have certainly been acquired can be transmitted, it is probable that physical characters can be transmitted also. The best instance of this is, I think, the eyes of flatfish, already mentioned; and until some better explanation can be found, we must assume that this is a case of use-inheritance."

Speaking of the "difficulty of explaining how great changes took place in the first pelagic organisms, notwithstanding the uniformity under which they existed," the author proposes, "as a possible way out of the difficulty, that the first variations were due to different organisms assimilating different substances with their food. * * * However this may be, we know nothing capable of initiating organic changes, except the action of external forces on protoplasm." So far from discrediting Neo-Lamarckism, these conclusions, in certain of their aspects, are just such as Neo-Lamarckians have urged in support of their theory.

In a chapter devoted to the discussion of 'Darwinism in Human Affairs,' the author undertakes to point out some more or less apparent analogies between natural selection and forms of selection seen in various human institutions. While emphasizing the operation of both physical and physiological factors in social and intellectual life, he suggests a significant caution against carrying such analogies beyond the warrant of facts. "The term 'social organism' is not, in fact, a happy one, because it is misleading. What, for instance, in the organization of an animal answers to the professions of law, medicine or theology? What to prisons or reformatories?"

As a series of lectures addressed to mixed audiences, and intended as popular expositions of Darwinian doctrine, they may serve in some

measure to extend interest and prompt further inquiry. But as a serious contribution to 'the already voluminous literature on Darwinism,' their value may be seriously doubted.

CHAS. W. HARGITT.

The Growth of Cities in the Nineteenth Century: A Study in Statistics. By ADNA FERRIN WEBER, Ph.D., Deputy Commissioner of Labor Statistics of New York. (Studies in History, Economics and Public Law, Columbia University.) New York, The Macmillan Company. 1899. Pp. xvi + 495.

It is one thing to know in a general way that a certain movement is in progress, and quite another to know its causes, rate of progress and full significance. That a remarkable concentration of population in cities has taken place during the present century is well known by all; that this change in the character of the population is a momentous one is appreciated by those who give thought to the matter; but the various causes that have given rise to this movement, and the full extent and influence of the change, are known to but few if any. This information Dr. Weber has attempted, and in the main attempted successfully, to supply in the present detailed statistical study.

With a remarkable command of authorities, both foreign and American, the author carefully traces the increasing concentration of population in large cities in all the important countries of the world. Successive chapters treat of the general phases of the movement and the methods adopted for its measurement, the history and statistics of urban growth in each country separately, the causes of the concentration shown, migration as a factor, the structure of city populations as regards sex, age, nationality and occupation, birth, death and marriage rates as affecting urban growth, a comparison of the physical and moral health of cities and country, the economic, political and social effect of urban concentration upon population, and finally a consideration of certain tendencies and remedies for evils to which the growth of cities has given rise.

The work abounds in statistical tables. One cannot but admire the painstaking way in which the problem has been considered in all its phases. At the same time the very detail with which this has been done is confusing. A proper discrimination has not always been exercised. Statistical tables have been inserted wherever the slightest opportunity offered, and many are of so slight importance that they could have been omitted without loss, or their results have been better stated in the body of the text. This is especially true where they are inserted merely for the purpose of illustrating collateral facts. The same criticism applies to the bibliographical references. While the constant reference to authorities and the insertion of bibliographical notes add materially to the value of the work, many of them are entirely unnecessary or foreign to the subject matter of the book.

Generally then, this monograph is a presentation of facts and bibliographical references concerning cities that will be of the greatest assistance to all persons wishing to study almost any problem connected with urban life. Its very exhaustiveness, however, makes it difficult for the ordinary reader to discriminate between the important and unimportant, or to learn what are the really significant results of this comprehensive study.

W. F. WILLOUGHBY.

J. N. BASKETT'S 'STORY OF THE FISHES.'

A RECENT book published by the Appleton's for their 'Home Reading Series' is 'The Story of the Fishes,' by J. N. Baskett. This is an attempt to popularize the anatomy and classification of the fishes, and gives as a separate 'Talk' an interesting account of the methods of fishing. The book is attractively presented for one of its kind: its figures are unusually good and it will prove a useful aid to a beginner—who is not fastidious in matters of scientific fact. The critical reader will find much to reprehend, for there are many inaccuracies and a deal of unbased theorizing. It is scarcely necessary to consider these shortcomings in detail, although a few should be noticed. In a pictorial phylogenetic tree the type of the ganoid is given as the 'gar-pike,' intended, of course, for *Lepidosteus*, but, unfortunately, the writer inserts the picture of a *gar-fish*, *Belone*, which is a well known and highly specialized

Teleost. Of less importance is the cut of the egg-case of a shark labelled as that of the skate, together with similar slips. The introduction of such phrases as 'some fish throw their great stomachs over creatures bigger than themselves, almost as a fowler throws his nets' is hardly to be commended. In the case in question, *Chiasmodon*, the exact mode of feeding of this abyssal fish is absolutely unknown, and probably will ever remain so. But the eversion of the stomach in a star-fish-like manner is a most startling guess. It would certainly be less of a shock to morphologists if they were told that this unique specimen of a deep water fish had captured its food in the way customary with great mouthed fishes, whose distensible jaws enable them to take extraordinary mouthfuls. Perhaps the most harmful part of the book is its theorizing. Without apparently a technical grounding in his subject, the author commends to his readers many independent hypotheses, of which these, selected at random, are examples: that gill-slits were not primary; that filamentous gills, as occurring in shark embryos, are the primitive form; that the teleostean swim-bladder has 'degraded' from a lung-like condition; that 'all our fishes tended more towards being air-breathing or land-haunting creatures formerly'; that, by the evidence of (tertiary) fossils, fishes which are now tropical must have occurred in icy polar seas.

B. D.

BOOKS RECEIVED.

La nature tropicale. J. COSTANTIN. Paris, Alcan. 1899. Pp. 315.

Our Native Birds. D. LANGE. New York and London, The Macmillan Company. 1899. Pp. ix + 162. $1.00.

Elementary Astronomy. EDWARD S. HOLDEN. New York, Henry Holt & Co. 1899. Pp. xv + 446.

Lamarckiens et Darwiniens. FELIX LE DANTEC. Paris, Alcan. 1899. Pp. 191. 2 fr. 50.

Analyse microchimique et spectroscopique. E. POZZI-ESCOT. Paris, Gauthier-Villars. 1899. Pp. 192. 2 fr. 50.

Report of the Proceedings of the Seventh Annual Meeting for the Promotion of Engineering Education, Vol. VII. Published by the Society. 1899. Pp. xxii + 193.

SCIENTIFIC JOURNALS AND ARTICLES.

WE regret to learn that *Natural Science* is compelled to suspend publication. It will be remembered that this was threatened last year but was temporarily averted by a change of editors and publishers. *Natural Science*, while maintaining a high standard, has been, perhaps, the most readable of the scientific journals, and it seems unfortunate that there should not be sufficient financial support to warrant its continuation. There is, however, no scientific journal in the world that is self-supporting, in the sense of paying editors and contributors for their work at what would be its market value in other directions of activity. This, of course, also holds for universities, museums, etc., and there appears to be no reason why scientific journals should not be endowed or subsidized, as is necessary in the case of other scientific institutions. Under the heading 'Eliminated' *Natural Science* takes leave in the following words:

It is one of the conditions of continued vigorous activity on an organism's part that income be at least equal to expenditure, and the same is true of journals. To try to sustain the activity when the aforesaid condition is not fulfilled is not uninteresting, but there are limits to the possibility of continuing it. We regret to say that we have reached these limits as regards *Natural Science*, of which this is the last number, so far as we are concerned. In spite of generous support from many during the past year, and our own endeavors in publishing and editing, the journal has not reached that measure of success which would seem to us to warrant another year's experiment. We make our bow, then, to the process of natural elimination.

The Journal of School Geography, which has hitherto been published as well as edited by Professor Richard E. Dodge, of the Teachers College, Columbia University, will hereafter be published by the J. L. Hammett Company, of Boston, Mass., and New York City. This change in the business management involves no change in the editorial management or policy.

SOCIETIES AND ACADEMIES.

THE NEBRASKA ACADEMY OF SCIENCES.

THE Academy held its Tenth Annual Meeting on December 1st and 2d in the botanical lec-

ture room of the State University at Lincoln. At this meeting the following programme was carried out:

FRIDAY, DECEMBER 1ST, 2 P. M.

Address by the President—The Present Status of Meteoric Astronomy, by G. D. Swezey.

Report on the Initial Work of the State Geological Survey, by E. H. Barbour.

Some Phases of the Dakota Cretaceous in Nebraska, by Chas. N. Gould.

Geology of Saunders, Lancaster and Gage Counties, by Cassius A. Fisher.

On the Origin of Gneiss, by C. H. Gordon.

Preliminary Survey of the Mammals of Nebraska, by R. H. Wolcott.

Notes on a Bibliography of the Zoology of Nebraska, by H. B. Ward.

A Genus of European Flies hitherto not Reported in North America, by W. D. Hunter.

The Tiger Beetles of Nebraska, by L. Bruner.

Davenport's Statistical Methods, by Ellery W. Davis.

A Rearrangement of the Phycomycetous Fungi, by Chas. E. Bessey.

Some Movements of Plants, by Wm. Cleburne.

SATURDAY, DECEMBER 2D, 9 A. M.

New Fossils from Nebraska and Wyoming, by E. H. Barbour.

Method of Collecting Fossils for the Nebraska State Survey, by Carrie A. Barbour.

A Simple Substitute for the Birge Net, by Charles Fordyce.

Methods of Plankton Measurement and their Comparative Value, by H. B. Ward.

A Plan for the Coöperative Study of the Fresh Water Fauna of Nebraska, by H. B. Ward.

A Few Suggestions concerning Collecting Nets, by R. H. Wolcott.

Pressure and Freezing Tests of the Building Stone of Southeastern Nebraska, by W. H. H. Moore.

A Brief Report on the Growth of Children in Omaha, by Wm. W. Hastings.

A New Nematode Disease of Strawberries in America, by Ernst A. Bessey.

Cold Waves, by G. A. Loveland.

Scarcity of Aquatic Life in Nebraska the Past Summer, by R. H. Wolcott.

Glacial Grooves in Cass County, Nebraska, by E. H. Barbour.

The officers elected for the ensuing year were:

President, Dr. H. Gifford, Omaha, Nebr.

Vice-President, Ellery W. Davis, Lincoln, Nebr.

Secretary and Custodian, Professor L. Bruner, Lincoln, Nebr.

Treasurer, G. A. Loveland, U. S. Weather Dept., Lincoln, Nebr.

Board of Directors: Professor J. H. Powers, of Doane College, Crete, Nebr.; Professor Charles Fordyce, University Place, Nebr.; Acting Chancellor C. E. Bessey, Lincoln, Nebr., and Dr. A. S. von Mansfelde, Ashland, Nebr.

On the evening of December 1st the members of the Academy and the public in general had the privilege of listening to a very interesting lecture entitled 'Observations of a Naturalist in Ecuador,' by August Rimbach, of the Department of Botany, University of Nebraska, at the close of which the members of the Academy sat down to a banquet, at which a pleasant social time was had.

LAWRENCE BRUNER,
Secretary.

WASHINGTON CHEMICAL SOCIETY.

THE regular meeting was held November 9, 1899.

The first paper of the evening was read by Dr. H. C. Bolton and was entitled, 'Reminiscences of Bunsen and the Heidelberg Laboratory, 1863–65,' and was printed in SCIENCE of December 15th.

The second paper of the evening was read by Dr. H. C. Bolton and was entitled, 'Chapters on the History of the Thermometer, I., The Open Air-Thermoscope of Galileo.'

The primitive form of the thermometer was invented about the year 1595 by Galileo; this is proved by extant letters addressed to him by his pupil and friend Sagredo. The instrument was an open air-thermoscope of the inverted type and was early applied to meteorological observations, to testing the temperature of fever patients and to noting temperatures of freezing mixtures.

The very common statement that the thermometer was the invention of C. Drebbel, of Holland, has no basis of fact, as shown by his own publications, copies of which were exhibited by the speaker.

The third paper of the evening was read by

Dr. F. W. Clarke and was entitled, 'The Action of Ammonium Chlorid upon certain Silicates,' by F. W. Clarke and George Steiger.

The authors described a series of experiments in which various silicates were heated in a sealed tube to 350° C. with dry ammonium chlorid. After leaching out the contents of the tube with water it was found that alkalies were removed as chlorids and replaced by ammonia, analcite and leucite are thus transformed into an ammonium leucite:

$$NH_4Al.Si_2O_6$$

which is perfectly stable at 300° and only begins to decompose when heated in the open air to 350°.

Some eight other silicates were given preliminary study and the reaction was found to be fairly general. The product from natrolite contained 8.3 per cent. of ammonia and other zeolites took up from four to six per cent. The investigation is to be continued.

The fourth paper was read by Dr. F. K. Cameron and was entitled, 'Hydrochloric Acid and Aqueous Phenol,' by F. K. Cameron and J. A. Emory.

The authors determined the freezing-point curve for hydrochloric acid solutions, saturated with respect to phenol. Each independently determined the concentrations of the various solutions and their freezing-points for intercomparison. The curve was found to be a straight line, parallel to the curve for water and hydrochloric acid alone, from which it would seem that the solubility of phenol is practically constant through the range of temperature involved, and the lowering of the freezing-point of the solvent is a purely additive effect of the two solutes.

The fifth paper was read by Dr. F. K. Cameron and was entitled, 'The System Water, Hydrochloric Acid and Phenol,' by F. K. Cameron and W. H. Krug.

On lowering the temperature of the system, solid phenol separates. But if the initial mass of water be relatively large its concentration with respect to hydrochloric acid is practically unaffected, while the solid phenol is separating and consequently the temperature of the phenol remains very constant. The freezing-point curve for phenol in contact with aqueous solutions of hydrochloric acid of various concentrations was determined. Its practical value for a rapid determination of the approximate strength of hydrochloric acid solutions was indicated.

WILLIAM H. KRUG,
Secretary.

NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the New York Section of the American Chemical Society was held on Friday evening, the 5th inst., at the Chemists' Club, and was well attended, over sixty members and their friends being present. Dr. C. F. McKenna occupied the chair, calling the meeting to order at 8:30 p. m.

After electing four delegates to represent the Section in the Council, the following papers were read:

(1) 'The Importance and Trend of Recent Work on the Chemistry of Life and the Products of Life,' by Jerome Alexander.

(2) 'A Preliminary Study of the Cobalti-Cyanides,' by E. H. Miller and J. A. Mathews.

(3) 'The Chemistry of Corn Oil. First Paper: Determination of the Constants,' by Herman T. Vulté and Harriet W. Gibson.

(4) 'A Practical Electric Furnace,' by A. J. Rossi.

Mr. Rossi exhibited a practical and easily constructed electric furnace with which he has prepared some very rich Titanium alloys, a specimen of which was exhibited with an invitation to break off pieces as samples. Although a sledge hammer was supplied no samples were taken. Arrangements are progressing toward the preparation of these alloys on a large scale for the steel trade.

DURAND WOODMAN,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting on November 29th, the scientific program consisted of a paper by Dr. C. C. Curtis, on Seaweeds, with lantern views illustrating the chief families and with a condensed summary of the modes of reproduction and other characteristics of each. Dr. Curtis also gave brief directions respecting methods of collecting and preserving the marine algæ, urging the collector to make microscopic study of all

forms, and pointing out the great need of further observation to clear up doubtful points in their reproductive processes.

President Brown exhibited specimens found by Dr. Meredith at Danville, Pa., of *Ajuga Genevensis* and of *Hieracium Pilosella*. The first had been observed on ballast in New York City, but not the latter.

On December 12th, the scientific program was opened by a paper by Dr. L. M. Underwood 'On the Genera of the Schizaeaceae.'

Dr. Underwood explained the peculiar detriscence of the sporangium by which this order of ferns is distinguished, illustrating with figures, and then sketching the history of the order. Linnæus put its species under Acrostichum; Richard was the first to begin segregation, erecting in 1792, the genus *Lophidium*. In 1703, *Schizaea* was founded by Smith, on a South African plant common through the Transvaal region, quite closely similar to our own species of New Jersey. Wallich founded another genus, *Actinostachys*, in 1822, on an East Indian form. Dr. Underwood considered these three genera to be valid, though recent German systematists, as Prantl, have not recognized them.

Swartz constituted another genus in 1800, *Mohria*, from Cape Colony, of which only one species is known. *Lygodium*, our best known genus, was established by Swartz in 1800, and includes one well known Atlantic species, *L. palmatum*, the climbing-fern.

Several other genera, as *Aneimia* and *Trochopteris*, were discussed, with remarks on principal species. About 90 species of the order have been published, largely American and tropical, especially the abundant Brazilian forms of Aneimia and allies.

Professor Lloyd suggested the interest attaching to Trochopteris as possibly a very primitive fern.

Dr. Underwood said it is sparsely represented from Brazilian collections, but perhaps because of its small size and habit of growth close to the ground, the largest specimen known being only three inches in diameter.

The second paper was by Dr. D. T. MacDougal, 'Studies on Hexalectris.' This rare southern orchid is of great interest on account of its supposed near relationship to Corallorhiza, which develops short coralloid undergrowths without roots, but producing a mycorhiza and sending out hyphæ into the soil. Material of Hexalectris from Alabama although possessed of somewhat similar coralloid growths, was found to contain no fungi, and to be without apparent adaption to growth by mycorhiza. No one seems to have seen seen the roots of this plant.

The third paper was by Dr. N. L. Britton, 'Notes on Species of *Crataegus*.'

Dr. Britton exhibited and discussed 34 species of the northeastern United States and remarked upon the great need of persistent field study in determining this genus. One must have flowers, mature leaves and mature fruit from any individual bush before he can begin to find its relationship to any other form. The most difficult part of the genus is perhaps the *C. tomentosa* group. Many southern species have recently been found to extend their range into Virginia, as *C. Chapmani*, *C. Carolina*, etc.; and others in Missouri, as *C. berberifolia*. The identity of the original of *C. coccinea* of Linnæus proves to have a special local interest. Linnæus seems to have had, as often, no specimen before him, but based his description on a plate of Plukenet (and another of Ray). Few herbarium specimens correspond well to the figure, which answers only to leaves of a shrub collected twice near New York, once by Mr. E. P. Bicknell along the Harlem River and once by the late Professor E. H. Day on Persimmon Island near New Rochelle, New York. The leaves bear a remarkable resemblance to those of *Betula nigra*. Search for similar specimens near New York should be made; the leaves are longer and with blunter, shallower lobes than in the commonly-received *C. coccinea*.

Dr. Britton is endeavoring to get together at the Botanic Garden a collection of these species, and now has over a dozen; but the wild stock is very difficult to grow and is impatient of transplanting. Most gardeners graft or grow from seed.

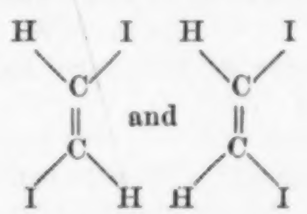
After discussion by Dr. Rydberg, President Brown and others, the Club adjourned.

EDWARD S. BURGESS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis of December 4, 1899, the following subjects were presented:

Dr. Edward H. Keiser talked informally on Some Derivatives of Acetylene, exhibiting specimens of the new liquid acetylene iodide discovered by him in January, 1899. He described the methods of making the compound, and gave an account of its chief physical and chemical properties. The liquid acetylene diiodide solidifies at —21° C. and boils at 185°. It has the percentage composition and molecular weight represented by the formula $C_2H_2I_2$, and is isomeric with the well known solid acetylene diiodide. The speaker announced the discovery of a new method of making the liquid acetylene diiodide, namely, by heating the solid compound to 260° in a sealed tube. The solid compound is thereby partially converted into the liquid compound. Similarly, if the pure liquid diiodide is heated to 260° in a sealed tube, on cooling down, the liquid will be found to have been partially converted into the solid compound. All the facts known indicate that these two iodides of acetylene are stereoisomers, and that their configuration must be represented by the stereometric formulas:



Since Dr. Keiser has found that the solid acetylene diiodide can be converted into fumaric acid, it follows that the first of the two formulas represents the solid acetylene diiodide and the second one the liquid diiodide. Further experiments upon these compounds are under way, and the attempt will be made to convert the liquid diiodide into maleic acid.

Dr. L. Bremer demonstrated some tests for glucose by means of anilin dyes, showing that nearly all of the 'alkaline' anilin dyes, when rendered basic by the addition of sodium hydrate, become decolorized, or have their color greatly modified, on heating, in case glucose is presented. The reactions shown were especially pretty in the case of methylene blue and safranine.

Professor Nipher announced that he had nearly completed preparations for the measurment of wind pressures on the sides of the main building of Washington University. The pressures are to be measured at various points along the west end of the building, having a width of about 50 feet, and along the north front, which is something over 200 feet in length. Simultaneous measurements of wind pressure and wind velocity and direction will be made. The method used is that tested by him on the trains of the Illinois Central Railroad during the summer of 1897. The method was described in No. 1, Vol. VIII., of the Transaction of the Academy of Science of St. Louis. An invitation was extended to members to visit the University and inspect the apparatus.

Professor H. Aug. Hunicke spoke briefly on some observations which he had recently made on the boiling temperature of hydrocarbons, from which it appeared that when T is the boiling temperature (absolute scale), ς is radius of gyration of the molecule, and a is a constant, then $T^2 = a\varsigma$. This holds for the entire series of saturated hydrocarbons, including all isomers. The speaker stated that his observations had not yet been extended beyond the series indicated.

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

DARK LIGHTNING.

MAY I be allowed to make some comment, on the interesting article by Professor Wood on 'Dark Lightning.' He is mistaken in supposing that my results on the same subject have only appeared in a photographic journal. The first announcement was a note read before the Physical Society of London on June 22, 1889, which was published in the *Electrician*, the *Philosophical Magazine* and the *Proceedings* of the Society.

Further details were the subject of a paper read at the Newcastle meeting of the British Association in August of the same year, and an abstract of it appears on page 507 of the Annual Report. Since then there have been numerous

references in the reports of the British Association Committee on Meteorological Photography and other places.

So long ago as August, 1889, I had shown conclusive proofs that the phenomenon was not due to any difference in the refrangibility of the light of the spark and that of the reversing light. I showed that the light of the sparks themselves could effect reversal of the images of others. Perhaps I may be allowed to quote from the paper.

"A plate was then exposed in the camera to a series of sparks, then to the direct light of more sparks without the interposition of the lens, and finally to a second set of sparks. The images of the first set show reversal while those of the second are direct.

"Next a plate was exposed to one set of sparks and without removing it from the camera the light of some more was diffused by holding a sheet of ground glass in front of the lens. Finally a second set of sparks was photographed. The results were similar."

These two experiments enabled me to reproduce the phenomenon of a bright flash crossing a dark one, and the reversal of one flash by the diffused glare of another.

In the second place plates were exposed to a number of spark images and then to a tolerably pure spectrum. The result was reversal in all parts, and by varying the length of exposure to the spectrum it was shown that the reversing power was simply proportional to the direct actinic power, maximum reversal occurring when the direct actinic effect of the reversing light was equal to that of the spark images. I was, therefore, entitled to sum up thus:

"Differences of refrangibility, therefore, do not seem to lie at the root of the matter. Neither can a difference of intensity be the cause of the reversal, for the less intense the light of the spark the more easily is its image inverted. It seems to me that the extreme shortness of the exposure to the electric spark may be the explanation."

A similar conclusion was indicated by the fact that the image of a spark very much out of focus did not lose the property of reversibility.

But how were we to account for the experiments showing that the spark images could be reversed by the light from other sparks? Was it possible that objects illuminated by these reversing sparks (card, objects in the room or ground glass) reflected or modified the light sufficiently to change its action on the photographic film?

I also tried to imitate the phenomena by brief exposure to other luminous objects trying in turn slits illuminated by gas, lime-light, magnesium and sunlight. I had no arc lamp available then. Here Professor Wood has done better, my results were nil and I congratulate him on his success.

However I should like to suggest that it is just possible that light from a source whose excitement is electrical *may* differ from other kinds of light in some manner at present unknown and that it is not safe to regard it as proved that the time element is the only one involved until the phenomena have been repeated without employing electricity at all.

For ten years the facts have been before the world. They were partly verified eight or nine years ago by Mr. Shelford Bidwell and it is highly satisfactory to find them verified again in so many particulars, by another physicist who has reached the same conclusions by means of somewhat different experiments.

ARTHUR W. CLAYDEN.
ROYAL ALBERT MEMORIAL COLLEGE,
EXETER.

SOCIOLOGY AND PSYCHOLOGY.

TO THE EDITOR OF SCIENCE: The relation of sociology to psychology suggested by Professor F. H. Giddings in his article, 'Exact Methods in Sociology' (*Popular Science Monthly*, December, 1899), is so misleading that it demands a word of protest from the psychologist. We must regard it as a capital mistake when any sociologist tries to make his science a means of measuring psychological quantity. Thus, when Professor Giddings (p. 155) would measure the 'intelligence' of societies by comparative statistics of literacy, for instance, he overlooks such facts as these: that mere reading, like talking, signifies little—the main point being what is read, whether Hegel or the yellow journal—and that how much is understood

must be measured. Some exceptional reader in a community may exceed in intelligence the sum of intelligence of all other readers, and even some illiterate may go beyond a number of literates. Hence only by the special study of individuals, and adding the results, can the sum total of intelligence for any community be found. But this is the task of psychology, not sociology, whose field is objective fact, social actualities like illiteracy, crime, etc., and their concomitant variations. Sociology can determine how many people read, and what they read, and the concomitant variation between the circulation of yellow journals and increase of crime; but it cannot measure the intelligence or the emotion implied, for the psychical illumination of social phenomena can come only from psychology.

HIRAM M. STANLEY.

LAKE FOREST, ILL., December 2, 1899.

NOTES ON INORGANIC CHEMISTRY.

A PECULIAR interest attaches to ammonium cyanate from the fact that it was the spontaneous conversion of this salt into urea, which first bridged over the gulf between the inorganic and organic, and in the hands of Wöhler gave the great impetus to the study of organic chemistry. Owing to its instability it has been very difficult to prepare ammonium cyanate in a pure condition. It is shown, however, in the *Proceedings* of the Chemical Society (London), by J. Walker and J. K. Wood, that the substance may be readily formed by mixing the cooled solutions of ammonia and cyanic acid in ether. It is also formed when the vapors of ammonia and cyanic acid are brought into contact, provided the reacting gases are sufficiently diluted with some indifferent gas. The transformation of solid ammonium cyanate into urea is facilitated by heat and very greatly accelerated by presence of moisture.

IN the same Journal, G. Dean describes a new series of atomic weight determinations of nitrogen. They are peculiar in their use of silver cyanid as the salt analyzed. The other atomic weights involved are those of potassium and bromin, hence the accurately determined Stas figures were available. The value found was $N = 14.031$ which is somewhat lower than the weight accepted by Clarke 14.04, and that by Richards 14.045. ($O = 16$).

IN a recent number of the *Comptes Rendus*, Moissan has described the formation of ozone by the decomposition of water by fluorin. If the temperature of the water into which the fluorin is led, is kept at or below zero, it is possible to get over 14 per cent. ozone (by volume) in the gas over the water. Moissan points out the possible practical application of this method, for though the electrolytic production of fluorin from hydrofluoric acid is still a rather difficult operation, it is not an expensive one. The ozone formed in this process has the advantage of being completely free from the oxides of nitrogen.

OF late years several explosions have taken place in factories where aluminum-bronze powder is ground. Investigations as to the cause of these explosions have been made by Stockmeier, and are reprinted in the *Chemical News*. The powder is perfectly stable, but its mixture with potassium chlorate will detonate even by rubbing. Bronze in contact with water decomposes it forming hydrogen, and it is to the presence of the hydrogen that explosions are probably due. The powder is hygroscopic and the dry powder can absorb 1.4 per cent. moisture from the atmosphere. Then in grinding up five or six kilos of bronze powder there could be moisture enough present to generate forty to fifty liters of hydrogen. A series of precautionary rules is proposed, the most important of which require dryness and absence of dust in the air about the grinding machine.

PROFESSOR E. T. ALLEN of the Missouri School of Mines calls attention in the *Chemical News* to a curious case of corrosion of gold plated weights which had been put away for the three summer months in a safe. The weights were covered with a white substance which proved to contain zinc and to be largely organic. The suggestion is made that the corrosion was caused by mould, the gold plating being, perhaps, not completely impervious, and the most positive metal, zinc, being removed from the brass. It appears to be well established now that certain hard waters have the property of dissolving the

zinc out of brass. A more important question is raised by Professor Allen, as to whether, under ordinary working conditions in the laboratory, gold plated weights are preferable to brass weights.

J. L. H.

BEEREN EILAND.*

THE Swedish Arctic Expedition of 1898, under the leadership of Professor A. G. Nathorst, spent a week on Beeren Eiland, mapped it on a scale of 1 : 50,000, and made numerous observations on its natural history. Chief among these were the geological researches which proved a prehistoric local glaciation, and by means of fossils showed the presence of rocks of three systems: Silurian, Middle Carboniferous, and Trias, previously unknown on the island. These discoveries led to another expedition to Beeren Eiland during the past summer. The expenses were borne by the Vega Stipend of the Swedish Geographical Society, the Lars Hierta Memorial Fund, and various private individuals. The leader was the geologist, J. Gunnar Andersson of Upsala, who had accompanied Professor Nathorst; the other scientific members were C. A. Forsberg, cartographer and meteorologist, and G. Swenander, zoologist and botanist. The expedition stayed on Beeren Eiland from June 22d to August 19th, and accomplished the following work:

The whole island was mapped in greater detail, and a special map, on a scale of 1:5000, was made of Ryssbamn, where the expedition had its headquarters.

From June 25th to August 16th complete meteorological observations were taken twice a day, as well as continuous observations by a self-registering barometer and thermometer. Eight series of observations were made on the tides, each series extending over from 8 to 51 hours, during which time the height of the water at intervals of half an hour was marked off on a section.

The botanist collected all the phanerogams previously found on the island, as well as *Koenigia islandica*, hitherto unrecorded. Exhaustive collections were also made of the lower plants, including the algæ of red and green snow. To investigate the influence on plant-growth of the continuous light of an Arctic summer, three series of cultivation experiments were carried out, as follows: First, in five places of nearly the same longitude, but at a distance of about 3 or 4 degrees of latitude from one another—namely, Svalöf, in Scania, Ultuna, near Upsila, Luleå, Tromsö, and Beeren Eiland—barley taken from the same sample was grown in soil from the same place. Only the climatic conditions, and especially those of light, were different in the different stations; thus there were completely dark nights in Scania, complete light the whole 24 hours on Beeren Eiland, with intermediate conditions at the intervening places. The material from the Scandinavian stations has not yet been brought in, so that the results of this interesting experiment are still awaited. Secondly, on open land at the Beeren Eiland station there were cultivated two precisely similar series of Arctic plants, of which one series stood in continual light, while the other was kept in complete darkness each night (8 p. m. to 8 a. m.). During the period of the experiment the development of these plants did not proceed very far, but the series kept in the light was obviously the more sturdy. The third experiment consisted in the cultivation, on a hot-bed, of a score of common Scandinavian plants. These also were in two similar series, one kept in the light, the other darkened by night. The experiment succeeded with 18, and of these 16 were clearly more sturdy in the light series, some of them yielding examples half as large again as those in the darkened series.

To the list of the island's fauna were added two birds: the Skua (*Lestris pomatorhina*) and the Spitzbergen form of *Mormon articus*. *Salmo alpinus* was found in a lake. Special attention was paid to the insects, which on isolated oceanic islands are of much interest to the student of distribution. Holmgren, the only entomologist who had previously visited Beeren Eiland, found there in 1868 only 9 species of Diptera and 1 Hymenopteron. The Swedish expedition has brought back a large collection of Diptera, not yet worked through, 4 Hymenoptera, 1 Neuropteron and 2 Coleoptera. Holmgren found only 2 Acarids; the present explorers have at least 10.

* From *Natural Science*.

The chief object of the expedition was a detailed geological investigation of the island. This has been successfully carried out with valuable results. A large collection of fossil plants from the coal-bearing series has been made; numerous fossils have been collected from all the marine strata, especially from the Trias. A geological map of the whole island has been constructed. The stratigraphy and tectonic geology of the whole island has been worked out, and there have been discovered in the southern part of the island a series of dislocations of Carboniferous age, which explains the topography of the hilly regions and the varying development of the Carboniferous system at various points.

Mr. Gunnar Andersson and his companions are to be congratulated on the amount of solid work they have accomplished, and we look forward to the publication of the detailed results with much interest. It should be mentioned that the proprietor of Beeren Eiland, Mr. Lerner (who happens to be a German), has helped the expedition, and hopes to welcome it back in some future year.

*THE STOCKHOLM FISHERIES CONFERENCE.**

IT is too soon yet to say that the International Fisheries Conference, which met at Stockholm this summer, will have any practical outcome; but the report of its proceedings suggests a general plan of investigations as regards hydrographical and biological work which, if properly organized and supported, should certainly be productive of useful and valuable results. The object of her Majesty's Government in deciding to take part in the conference may be best summarized in the language of the instructions given to Sir John Murray, one of the British delegates:

"You should propose that the scientific investigations shall be accompanied by a practical *exposé* of the steps to be taken in order to bring the exercise of sea-fishing more in accord with the natural conditions regulating the growth and increase of the fish, and thus permanently increase the supply of fish in the markets of the countries adjoining the North Sea.

"In making this proposal, which you should do at the outset, you should make it clear that the principal object which her Majesty's Government have in view, in directing you to take part in the conference, is to secure a careful inquiry into the effect of present methods of fishing in the North Sea, and you should give every assistance in promoting a scheme for determining whether protection against overfishing is needed, and, if so, where, when and how such protection should be given."

The countries taking part in the conference were Great Britain, Germany, Russia, Denmark, Norway, Sweden and Holland. The representatives of the United Kingdom were Sir John Murray, of the *Challenger* Expedition, Mr. W. Archer, Chief Inspector of Fisheries, and Professor W. D'Arcy Thompson, of Dundee University, while Dr. Nansen was one of the delegates from Norway.

Most persons who have given a thought to the subject must be convinced that a rational treatment of fishery questions should be based on scientific inquiry; and in the opinion of the conference the best way of arriving at satisfactory results in this direction is by international coöperation. The scheme of investigations, having for its ultimate object the promotion and improvement of fisheries through international agreements, which the conference resolved to recommend to the Governments of the countries concerned, embraces a program for hydrographical and biological work in the northern parts of the Atlantic Ocean, the North Sea, and the Baltic and adjoining seas. These investigations, it is added, should be carried out for a period of at least five years.

Among the hydrographical researches proposed are: The distinction of the different water-strata, according to their geographical distribution, their depths, their temperature, salinity, gas-contents, plankton, and currents, in order to find the fundamental principles not only for the determination of the external conditions of the useful marine animals, but also for weather forecasts for extended periods in the interests of agriculture. The biological work would include the determination of the topographical and bathymetrical distribution of eggs and larvæ of marine economic fishes; the continued investigation of the life, history and conditions of life of young fishes of economic species in their post-larval stages, with special reference to their local dis-

* From the London *Times*.

tribution; the systematic observation of mature marketable fishes with reference to their local varieties and migrations, their conditions of life, nourishment and natural enemies; observations on the occurrence and nature of fish food at the bottom, the surface, and intermediate waters down to the depths of at least 600 meters; and determinations of periodic variations in the occurrence, abundance and average size of economic fishes and the causes of the same. These are briefly some of the principal points mentioned in the program of work recommended.

To carry out these investigations on a basis of international coöperation, and in order to ensure uniformity of method, it is proposed to create an international council with a central bureau and a central laboratory at an estimated annual cost, including salaries of staff, of £4,800, to be divided among the Governments concerned. No place is mentioned for this central bureau, which, however, should be conveniently situated for hydrographical and biological researches. It is considered desirable that the work should begin on May 1, 1901.

DEVONIAN FISHES FOR THE AMERICAN MUSEUM.

THROUGH a generous gift of a Trustee, Mr. William E. Dodge, the American Museum of Natural History has recently purchased the Jay Terrell collection of fossil fishes of Ohio—forms which from their great size and formidable dentition have long been known as among the most interesting as well as the rarest of fossil vertebrates. The present collection is the result of over six years' energetic and skillful field work. It is the fourth collection which Mr. Terrell has formed: the first was secured by the late Professor J. S. Newberry, and is now preserved at Columbia University; the second is at Harvard, and the third is at Oberlin. Of popular interest in connection with the present purchase is the fact that material is now at hand for exhibiting as a single specimen the parts of the gigantic Placoderm Dinichthys Terrelli. The specimen is unusually complete and appears to be the largest hitherto secured—a jaw alone measuring nearly two feet in length. Much of the collection is of exceptional importance: it includes associated head plates of Titanichthys, jaws of Diplognathus, and immature jaws of Mylostoma.

BASHFORD DEAN.

THE SPELLING OF 'PUERTO RICO.'

IF anything further were needed to determine the proper spelling of the name of our new West Indian Island possession, it has been supplied in a decision of the President of the United States himself. Through Secretary of State Hay, under date of December 16, 1899, the President declares in favor of the spelling *Puerto* Rico, basing his decision more especially on the fact that this is the spelling followed by the people of the island. He was doubtful mindful also, however, that *Puerto* is good Spanish for port just as *Rico* is Spanish for rich. He sustains the decision of the U. S. Board on Geographic Names, made some years ago and since followed by some of the Government departments but not by others.

W. F. MORSELL.

SCIENTIFIC NOTES AND NEWS.

AS SCIENCE goes to press a number of our most important scientific societies are holding meetings in New Haven, Washington, New York and Chicago. The American Society of Naturalists meets at New Haven, together with the societies more or less closely affiliated with it, namely, The American Morphological Society, The Association of American Anatomists, The American Physiological Society, The American Psychological Society, The Society for Plant Morphology and Physiology, The American Folk-lore Society, Section H, Anthropology, of the American Association. A Bacteriological Society will at the same time be organized. The American Chemical Society also meets at New Haven. Western naturalists are organizing a society at Chicago. The Geological Society of America is meeting at Washington and the American Mathematical and Physical Societies at New York. We hope to publish in subsequent numbers full accounts of the meetings of these societies.

PROFESSOR WILLIAM HARKNESS, astronomical director of the U. S. Naval Observatory,

was retired as rear admiral on December 17th, on reaching the age of sixty years. Professor Stinson Joseph Brown has been appointed to the position. He was born at Hammondsport, N. Y., in 1854, and graduated from the Naval Academy in 1876. He was employed in the U. S. Coast and Geodetic Survey and in 1881 obtained by competitive examination a professorship of mathematics in the Navy.

M. LEMOINE has been elected a member of the Section of Chemistry of the Paris Academy of Sciences in the room of the late M. Friedel. M. Lemoine received 32 of the 57 votes cast.

PROFESSOR JOSIAH ROYCE of Harvard University, sailed from New York on December 27th, in order to give his second course of Gifford Lectures at the University of Aberdeen. Professor Royce will also lecture at Glasgow and Oxford. He will return to Cambridge early in February.

PROFESSOR ALBERT P. BRIGHAM, of Colgate University, who has been abroad with his family for ten months, has returned, and will resume his college duties with the new term. During his absence, Professor Brigham has traveled extensively in England, Scotland, Germany, and Switzerland, and has spent a number of weeks in study and literary work at Oxford and Munich.

MR. ARTHUR HENRY SAVAGE LANDOR, the explorer, arrived in New York from England on December 23d.

AMONG the passengers by the mail steamer *Bakana* for the west coast of Africa on December 8th were three medical men, Dr. Christopher, Dr. Stephens, and Mr. A. Pickels, bound for Sierra Leone and Lagos. They are going out at the expense of the Colonial Office, having been selected by the Royal Society, and their work will be carried on under the auspices of the Liverpool School for Tropical Diseases.

DRS. WILLIAM OSLER and Howard Kelly, of Baltimore, have been elected honorary members of the Royal Academy of Medicine of Ireland.

THE Royal Geographical Society London has elected the following honorary corresponding members: Captain Meliton Carbajal (president of the Peruvian Geographical Society), Professor A. Bertrand (professor of topography and engineering in the University of Santiago, Chile), and Señor D. Samuel A. Lafone Quevedo, a distinguished geographer and ethnologist of Buenos Ayres.

MR. BAILEY WILLIS of the United States Geological Survey, addressed the members of the Geological Club of the University of Chicago on November 29th, on 'A Pacific Atlantis.'

THE centennial anniversary of the birth of Joseph Henry, was celebrated at his birthplace, Albany, on December 16th, at a joint meeting of the Albany Institute and the Albany Historical and Art Society. The exercises were held at the Albany Academy where Henry taught for many years before going to Princeton and the Smithsonian Institution.

THE death is announced of Dr. Birsch-Hirschfeld, professor of pathology in the University of Leipzig, at the age of 57 years.

THE death is also announced of Dr. John Frederick Hodges, professor of agriculture and lecturer on medical jurisprudence in Queen's College, Belfast. Dr. Hodges was the author of books on chemistry and agriculture and was perhaps the oldest member of the Chemical Society of London, having been elected a fellow in 1844, three years after the formation of the Society.

DR. ARTHUR COWELL STARK was killed by the explosion of a shell on November 18th at Ladysmith, where he was serving as a volunteer on the medical staff. Dr. Stark was an authority on South African ornithology and had just completed the first volume of a work on South African birds for Mr. W. L. Sclater's Fauna of South Africa.

WE regret also to record the death of Mr. N. E. Green, an artist who accomplished important scientific work in making astronomical drawings. He was a past president of the British Astronomical Association.

THE American Museum of Natural History has secured through the generosity of President Jesup the second part of the Cope collection of fishes, amphibia and reptiles. It will be remembered that by the will of the late Professor

Cope the proceeds of the sale form an endowment fund for the Philadelphia Academy of Natural Sciences.

ACCORDING to a notice in the New York *Commercial Advertiser* of December 16th, the Peabody Museum at New Haven has been enriched by a valuable accession to the anthropological collections. The addition consists of Mexican and Guatemalan antiquities, about 350 pieces in all, which were brought from but two localities—Sempoala, state of Vera Cruz, and Tacana, Guatemala.

THE Hon. Walter Rothschild, M.P., treasurer to the Middlesex Hospital, has sent a donation of £100 towards the maintenance of the new research laboratories for the investigation of the cause of cancer in connection with the new wing for female cancer patients of that institution.

MR. ANDREW CARNEGIE has offered $50,000 for a public library in Oil City, Pa., on the conditions that a site be donated, and that the city appropriate $3,000 annually for the library's support.

IT is stated in *Natural Science* that the Mortimer Museum of Antiquities at Driffield, Yorkshire, contains a very good local collection. Its owner has offered it to the East Riding County Council for half its value, the value to be decided by two referees, one to be appointed by the Council and the other by Mr. Mortimer.

A COMMUNICATION was presented to the Senate on December 20th, from the Regents of the Smithsonian Institution suggesting the appointment of Mr. Richard Olney to fill the vacancy on the Board caused by the death of William Preston Johnson. Senator Hoar said he thought that it was the first time that the Regents had made such a suggestion. No action was taken by the Senate.

INVITATIONS for the next agricultural conference for the West Indies have been issued by the British Department of Agriculture. It is proposed to hold the conference at Barbadoes, and the dates fixed are Saturday the 6th, and Monday, the 8th of January next. The president, Dr. D. Morris will deliver the opening address. A new feature will be the presence of representatives of the leading agricultural societies in the West Indies. The list of subjects to be dealt with covers, practically, every branch of West Indian agriculture.

AT a meeting of the Fellows of the Royal Botanic Society, London, on December 8th, the chairman stated that it was very satisfactory to know that during the year 203 new Fellows had been elected, that number being higher than in any previous year since the foundation of the society. The largest number in other years was in 1850, when 186 Fellows were elected.

THE British Institution of Electrical Engineering held its eleventh annual dinner on December 6th. The President, Professor Sylvanus P. Thompson occupied the chair, and speeches were made by Mr. R. E. Crompton, General Sir R. Harrison, Sir W. C. Austen-Roberts, and Lord Kelvin.

Nature states that in connection with the British Institution of Electrical Engineers, a number of local centers are being established where papers will be read and discussed at the same time, or shortly after, their reading in London. In Cape Town these informal meetings have been held for some time past, and advance copies of the Institution's papers have been read at them. A meeting for the formation of a northeastern center was held recently at the Durham College of Science, and the Council have received a petition for the establishment of a similar organization in Dublin.

THE proprietors of the Marconi system of wireless telegraphy have offered the use of twenty sets of instruments to the Government on payment of $10,000 in the first instance and $10,000 a year for their use. Secretary Long has under consideration the advisability of asking Congress to make a special appropriation for the purpose.

AN institution on the lines of the Pasteur Institute, bearing the name Alfonso XIII., has been established at Madrid.

A DEPUTATION appeared before the Edinburgh Town Council on November 21st to urge the establishment of a zoological garden in that city.

THE thirteenth International Medical Congress will be held at Paris from the 2d to 9th of August, 1900, in connection with the Paris Exposition. The work of the Congress is divided into five classes, each of which is sub-divided into from two to nine sections. The classes are, (1) biological sciences; (2) medical sciences; (3) surgical sciences; (4) obstetrics and gynecology, and, (5) public medicine. The biological sciences are divided into three sections (*a*) descriptive and comparative anatomy, (*b*) histology and embryology and (*c*) physiology and biological physics and chemistry. An American National Committee has been formed with Dr. William Osler as Chairman, and Dr. H. B. Jacobs (3 West Franklin street, Baltimore, Md.), as Secretary.

THE third International Ornithological Congress will be held from the 26th to the 30th of June, 1900, as one of the series of official congresses of the Paris Exposition. The work of the congresses has been divided among five sections, as follows: (1) Systematic ornithology: classification; species; anatomy and embryogeny of birds; paleontology; (2) geographical distribution; appearance of rare species in certain districts; (3) biology; oölogy; (4) economic ornithology; (5) organization and working of the international ornithological committee.

FROM the 18th to the 23d of June an International Congress of Mining and Metallurgy will be held at Paris. The program proposes the following subjects for discussion: Mining, use of explosives in mines; use of electricity in mines; mining at great depths; labor-saving methods as applied to mining. Metallurgy: progress in metallurgy; progress in the metallurgy of iron and steel since 1899; application of electricity to metallurgy—(*a*) chemical, and (*b*) mechanical; progress in the metallurgy of gold; recent improvements in the dressing of minerals.

THE Congresses of the Paris Exposition also include the first International Congress of Philosophy which will be held from the 2d to the 7th of August. There will be four classes: (1) general philosophy and metaphysics (2) ethics, (3) logic and (4) history of the sciences and history of philosophy. Under the third class especially a number of topics of interest to men of science are proposed for discussion.

AN International Congress of Ethnology will be held in connection with the Exposition, on August 26 to September 1, 1900. There will be seven sections, dealing respectively with general ethnology, sociology and ethics; ethnographical psychology; religious sciences; linguistics and palæography; sciences, art, and industries; descriptive ethnography.

THE *British Medical Journal* states that an attempt is being made to ascertain in which house in the Hotwell it was that Humphrey Davy discovered the anæsthetic powers of nitrous oxide. It is a well known fact that Davy was assistant to Dr. Beddoes, who had, in 1798, opened a house called the Pneumatic Institute for the treatment of disease, and more particularly phthisis by the inhalation of some of the then newly discovered gases, the Hotwell at Bristol being then a very popular watering place. Davy, it appears, was in the habit of administering the nitrous oxide to all comers at 2d. a dose, and from all accounts it was a popular amusement to go to the Institute and have the gas; the usual modern accompaniment of tooth drawing was omitted. The Institute appears from Stock's memoir of Dr. Beddoes to have been in Hope Square, but the common report puts it in Dowry Square. The Clinton Antiquarian Society, who are pursuing the investigation, hope to put a tablet on the house commemorating the fact that nitrous oxide was there found to have anæsthetic powers.

PROFESSOR WILLIS L. MOORE, Chief of the U. S. Weather Bureau, has with the approval of the Secretary of Agriculture drafted a bill which has been introduced by the Hon. James W. Wadsworth in the House of Representatives. Professor Moore thus summarizes its chief features: It apportions appointments among Senators, Representatives, and Delegates, without regard to their political faith. It provides that candidates shall be nominated by the representatives of the people, under such rigid restrictions as to age, physical condition, and education as render it difficult, if not impossible, to effect the permanent appoint-

ment or the promotion of an unfit person. It prohibits the use of political or other influence to secure promotion or assignment, and I believe properly coördinates the prerogatives of Congress and the executive officers of the government in the matter of the appointment to and the control of the federal service. It places each employee strictly upon his merits and compels him to work out his own salvation, while the present law leaves all this to the caprice of the executive officer or the rules of a commission. It prohibits the removal of any employee for political reasons, and makes his tenure of office secure so long as his services are advantageous to the government, *and no longer.* Without one cent of expense to the Government, it provides for the separation from the public pay rolls of disabled or aged officials, and at the same time provides support in their hours of need.

PROFESSOR WM. E. HOYLE, in the *Library Association Record* of November, speaks as follows of the *Concilium Bibliographicum* of Zurich and its work: "Zoologists are deeply indebted to Dr. Field for the self-sacrificing energy with which he has unstintingly devoted his time and his money to the advancement of the bibliography of their science, and it is not a little surprising that the Royal Society, which is maturing schemes for a card bibliography of the whole of science literature, should not have taken counsel with the only man who has had extensive practical experience of this kind of work. There is no doubt that when the admirable qualities of the catalogue become more widely known in England, more and more zoologists will subscribe to it and provide themselves with the cards bearing on the subjects of special value to them. Few private individuals will take the whole catalogue, unless they are prepared to spend time upon it and to provide ample space for it. It will be much more suitable for University and City libraries, the great storehouses of bibliographical information, to become subscribers and take full charge of all the cards. An attendant would then be entrusted with their arrangement and would be quickly able to direct any inquirers to the right part of the catalogue, which would be kept intact and securely fixed on rods like other card catalogues with which we are already familiar."

THE class in Soil Physics at the University of Illinois as a part of their laboratory work, have undertaken a special study of samples of soil taken at different depths from two plats of ground. One of the plats has been subjected to a continuous cropping of corn for twenty-four years, and the other to a rotation of corn, oats, and oats and clover, for the same length of time, neither receiving any addition of fertilizers during the period, and all of the stalks and straw in case of the grain crops being each year removed from the plants. The results of the examination so far show that there has been a marked loss of humus in the soil which has been subjected to constant cropping of corn. This loss is greatest in the surface nine inches of the soil and amounts to more than 50 per cent. of the entire humus content as compared with that of the rotation. This loss of humus is evinced by a decrease in the producing capacity of the soil, which is now only one-third to one-half of that of average Illinois soils under ordinary farm conditions. It is also shown by a marked change in the color and physical texture of the upper layers of the soil, the soil being of a lighter color owing to the loss of organic and vegetable matter and to the ultimate soil particles being apparently reduced in size, which gives the soil an increased capillary power.

WE learn from the London *Times* that with a view of making the law on the subject of wild bird protection uniform throughout the metropolitan police district, the London County Council intends to apply to the Home Secretary for the issue by him of a new order under the Wild Birds Protection Acts in regard to the County of London. Under the proposed new order the time during which the killing and taking of wild birds is prohibited by the Act of 1880 is extended so as to be from February 1st to August 31st. During the period from September 1st to January 31st the killing or taking of certain birds is also prohibited. These will, therefore, be protected during the whole year. The list of birds so protected includes the chaffinch, cuckoo, goldfinch, honey buzzard, gulls, kingfisher, lark, landrail, linnet, martin, swal-

low, nightingale, starling, swift, wren, magpie, garden warbler, owl, and redstart. A further effect of the order will be that all wild birds will be protected on Sundays during the whole year. The Parks Committee of the Council think this a most necessary step, as Sunday is the day on which the bird-catcher and cockney sportsman have the greatest opportunity of carrying on their operations. Another clause of the order adds the names of several birds to those in the schedule of the Act of 1880. The effect of this is to increase the penalty with regard thereto, as any person convicted in connection with the scheduled birds is liable under the Act of 1880 to a penalty in each case of £1, whilst for wild birds not in the schedule the penalty is by that Act fixed at 5s. in each case. The birds now to be added to the schedule of 1880 are the bearded tit, buzzard, chaffinch, honey buzzard, hobby, kestrel, magpie, martins, merlin, osprey, shrikes, swallow, swift, and wryneck. Under the last clause of the order it will be an offense to take or destroy the eggs of any of the birds set out in the schedule attached. Included in this schedule are the cuckoo, goldfinch, kingfisher, linnet, lark, magpie, martins, nightingale, starling, swallow, wren, redstart, and swift. The common house and hedge sparrow apparently receive no special protection under the order, except that provided by the close time from February 1st to August 31st.

DR. BURRILL, of the University of Illinois, has sent to Dr. Reynolds, Health Commissioner of Chicago, a report of bacteriological investigations upon the waters of the Illinois and Michigan canal and of the Illinois and Mississippi rivers, altogether extending from Chicago to St. Louis. The report covers the months of June, July, August, September, October, and November, and gives the monthly average number of bacteria found in a cubic centimeter of water taken from each of thirty-eight stations. The laboratory work was done by Mr. James A. Dewey. The figures, as tabulated, show that the whole stream has been, during the time, greatly polluted, but they also show that the water becomes rapidly purified as it flows along from the source of contamination. At Ottawa and LaSalle the number of bacteria has decreased from several million to a few thousand in a centimeter of water. Above Peoria the stream is nearly free from these organisms. Below this city the numbers rise again so as practically to equal those in the canal at Bridgeport. Farther down, the water again becomes gradually less infected, so that at the mouth of the Illinois there are less bacteria than occur in the waters of the Mississippi river.

WE learn from the London *Times* that at a recent meeting of the Departmental Committee on Preservatives and Coloring Matters in Food, Mr. J. Kellitt, of Liverpool, speaking on behalf of the Grocers' Federation, said that it was now absolutely necessary to use borax or boracic acid for ham, bacon, and butter, on account of the great demand for a mild-cured article. Borax, in his experience, was the most effective preservative he had known, especially for stopping fly-blow. Quite 75 per cent. of the hams and bacon sold in this country were treated with the preservative. After the bacon or ham had been prepared for cooking by the consumer most, if not all, of the borax had disappeared, so that in actual consumption the percentage of boracic acid present at the time the article was consumed must be small. Captain T. W. Sandes, who had started a creamery in county Kerry for the benefit of his tenants, said that he used generally to send to England butter that they called saltless—that is, butter that was cured with one pound of preservative to the hundredweight of butter. The preservative he used was boracic acid. The saltless but preserved butter was bound to be good butter, because impurities could be so easily detected in it, whereas the heavy salted butter need not be, as the salt, more or less, covered a few of the 'sins' in the butter. Mr. J. Wheeler Bennett, who appeared on behalf of the London Chamber of Commerce, said that the trade in Canadian hams had increased since 1889 from something like $300,000 to $1,800,000 in 1898, and this he attributed to the use of preservatives. If the treatment of hams by borax were prohibited, the whole of this gigantic trade from Canada would come to an end. There was a very large and increasing trade in Australian butter, and that trade hinged upon the use of borax, the

butter being washed in a solution of the preservative. The committee then adjourned.

UNIVERSITY AND EDUCATIONAL NEWS.

ON December 20th, the University of Pennsylvania's free museum of science and art at Philadelphia, one of the late Dr. William Pepper's cherished hopes, was formally opened in the presence of several thousand people. Immediately following the presentation to the board of trustees of the museum, a bronze statue of the late Dr. Pepper, the gift of friends, was unveiled. The presentation speech was made by ex-Senator George F. Edmunds, in behalf of the Dr. Pepper testimonial committee. In connection with his address, Mr. Edmunds was delegated by Mrs. Frances Sergeant Pepper, the widow of Dr. Pepper, to present to the university trustees, as her memorial to the memory of her husband, a gift of $50,000 as a fund to carry on the work started by Dr. Pepper.

THE Presidents of Harvard University, Columbia University, Johns Hopkins University, the University of Chicago, and the University of California have issued an invitation to sister institutions to a conference to be held in Washington some time in February, 1900, for the consideration of problems connected with Graduate work. The invitation says: "There is reason to believe that among other things the deliberations of such a conference as has been proposed will (1), result in a greater uniformity of the conditions under which students may become candidates for higher degrees in different American universities, thereby solving the question of migration, which has become an important issue with the Federation of Graduate Clubs; (2), raise the opinion entertained abroad of our own Doctor's degree; (3), raise the standard of our own weaker institutions.

THE engineering laboratory for Stevens Institute, Hoboken, N. J., provided by a gift of $50,000 from Mr. Andrew Carnegie will be begun at once. The University of Wisconsin will also erect an engineering building, the Legislature having provided $100,000 for the purpose.

IT is also announced that the Western Reserve University has received $12,000, from Mr. and Mrs. Samuel Mather for the purchase of books; Wabash College $5,000 from Mrs. W. R. Jones toward a residence for the president; and New York University $2,500 from Miss Anna M. Sandham for prizes in public speaking.

IT is said that Mr. James M. Munyon will give $2,000,000 to found an industrial school for orphan girls in Philadelphia on the same general lines as Girard College.

GIRTON COLLEGE, Cambridge, is being enlarged at a cost of £40,000.

THE main building of Buchtel College, at Akron, O., including the laboratories, library and dormitories, was recently burned. The loss is $100,000, with $65,000 insurance.

OXFORD UNIVERSITY is planning the establishment of the degrees of Doctor of Letters and Doctor of Science, to be conferred for research work.

THE Sheffield University College, England, has not succeeded in making arrangements for the occupation of the site of Wesley College, and it is now proposed to acquire a strip of land adjoining the Botanical Gardens on which to erect a new block of buildings.

DR. F. W. BANCROFT has been appointed instructor in physiology at the University of California.

MR. LOYE H. MILLER, of the University of California, goes to Oahu College, Honolulu, H. J., as professor of chemistry and natural sciences.

MR. J. H. RIDGWAY, brother of the ornithologist of the Smithsonian Institution, has been engaged as taxidermist at the University of Illinois and is now at work on the museum specimens. Mr. Ridgway has been connected with the National Museum, the University of Iowa, the Iowa Agricultural College, and the University of Ohio.

PROFESSOR RÖNTGEN has finally decided to accept the call to the University of Munich.

MR. A. W. W. DALE, M.A., fellow in classics of Trinity Hall, Cambridge, has been appointed Principal of University College, Liverpool, in place of Mr. Glazebrook, who has retired on his appointment to the office of Director of the National Physical Laboratory.

SCIENCE

NEW SERIES.
VOL. X. No. 261.

FRIDAY, DECEMBER 29, 1899.

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00